ENGINEERING AND
BOILER HOUSE REVIEW

ESTABLISHED 1899

& SIXPENCE

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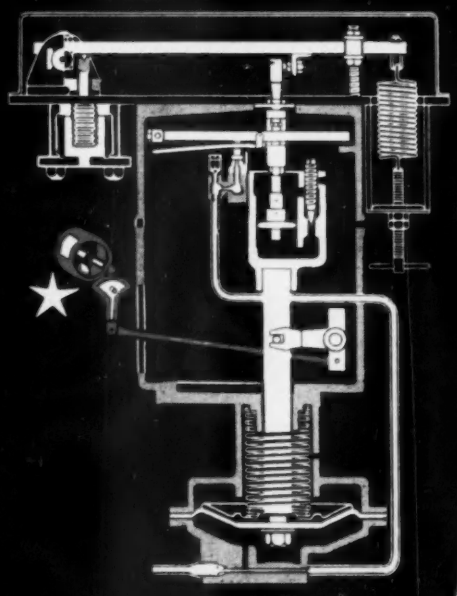
ELECTROFLO-SMOOT

Electronic

BOILER CONTROL



Steam generation is a mechanical process. Its successful automatic control requires not only the precise, immediate detection of departures from norms, but *power—precisely applied*—at the final regulating means.

Electroflo - Smoot Control employs pneumatics, hydraulics and electronics solely or in combination—with good sense and unrivalled experience—to suit the specified plant and its operating conditions.

The advanced type electronic system not only eliminates distance transmission lags in high capacity, high energy level steam generators, but—through "steam load" control—it provides the shortest path from the electrical load change to the combustion rate. **Ask for Publication No. 5.848.**

★ Electric signal sender to receiving regulator or power unit. System includes integral feedback and bumpless transfer from automatic to manual (constant rating) control.

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Member of Elliott-Automation Group

This is one of a series of advertisements by ***RITCHIE CALDER*** *which is appearing in the National Press to illustrate how atomic power is helping to open up the frozen wastes of the Arctic*

Mosquitoes Traced by Radioactive Nectar

PEOPLE do not usually associate mosquitoes with the Frozen North, but Arctic Old Hands will tell a tenderfoot: 'Mosquitoes! They are so big we skewer them on spigots and roast them!'

That is an exaggeration, but they are certainly 'man-eaters'. Fortunately they do not, like the anopheles of the tropics, transmit malaria; but when the icebound swamps unfreeze in the Arctic summer they swarm in such vast numbers, and bite with such blood-thirsty persistence, that the settlers' lives become unbearable. Indeed, it can be said that the mosquitoes are a bigger obstacle to settlement and development of Arctic regions than the cold or the six-month long night.

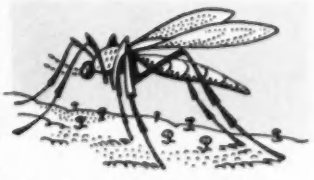
RADIOACTIVE ISOTOPES

Something will have to be done about these hostile and voracious insects. Already scientists are hard at work studying their habits. Ingenious methods are being devised to keep track of the swarms, not the least of which enlists the help of nuclear energy.

It is known that the mosquitoes drink the nectar of the Arctic poppies (again, people do not usually associate flowers with the Frozen North) and the experts are feeding the poppies with an artificial fertiliser containing radioactive isotopes, which are, of course, by-products of the release of atomic energy.

In the Arctic poppy then, this radioactive fertiliser finds its way into the nectar. The mosquitoes sipping the nectar, pick up the radioactive elements. And from there on, they are marked. They carry in their bodies a 'radio transmitter' and the scientists can follow them wherever they go and so find out vital information concerning their habits — information that will lead to their effective control.

The end result of using this by-product of nuclear energy to plot the mosquitoes' activities will help to make the Frozen North a more comfortable place in which to live and work. And this, in turn, is an important factor in preparing the way for the time when atomic power itself releases the immense industrial resources of the Far North.



MITCHELL ENGINEERING *are designing and constructing Nuclear Power Plant to meet world needs in the New Atomic Age*

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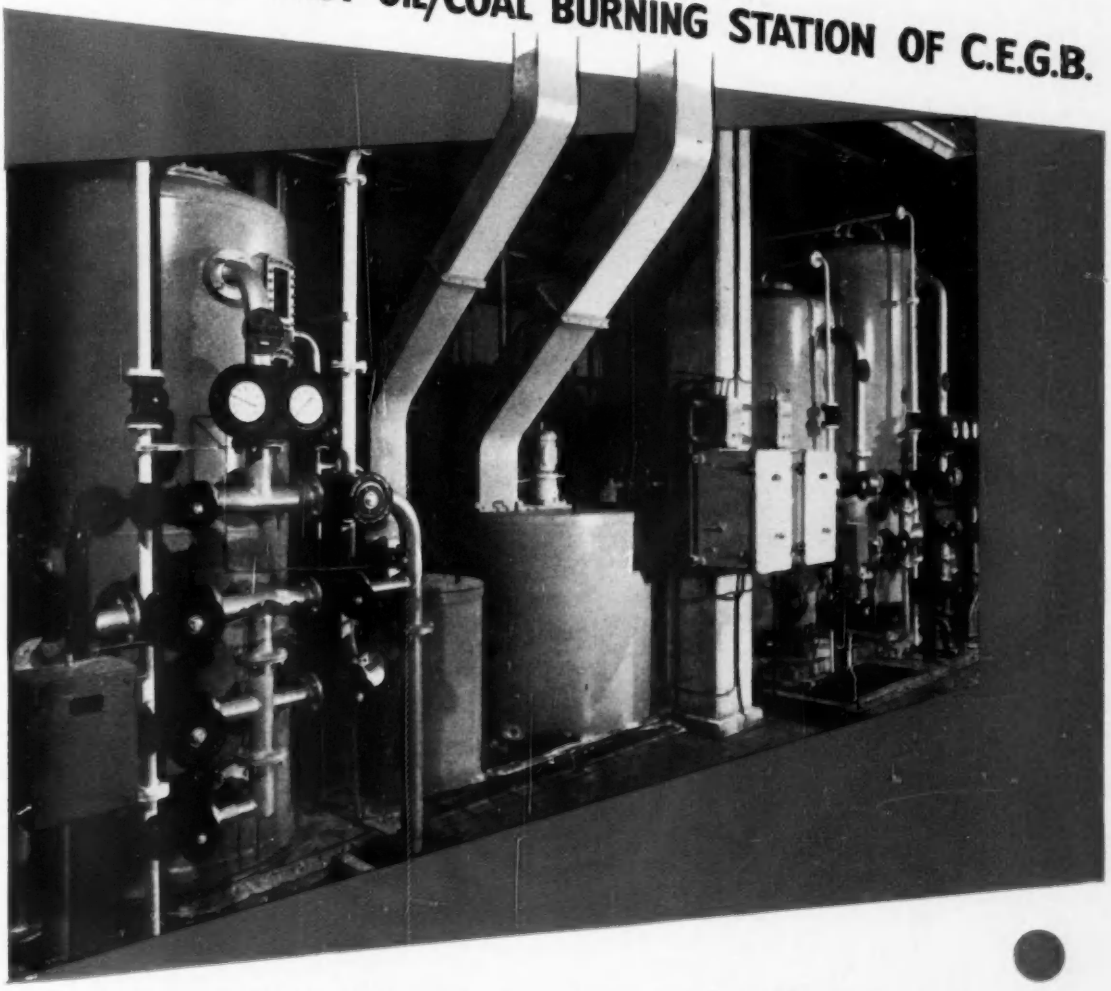

The boilers at C.E.G.B. Marchwood Generating Station operate at 925 lb. per sq. inch, and are provided with "Deminrolit" treated make up feed. There is no split responsibility with a "Deminrolit" Plant because Permutit design and manufacture the Plant, also develop and manufacture their own Ion Exchange Resins. This is exclusive to Permutit.

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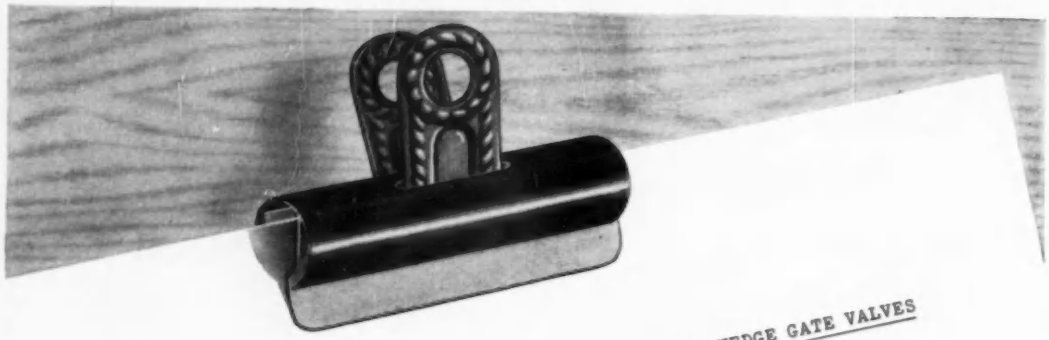

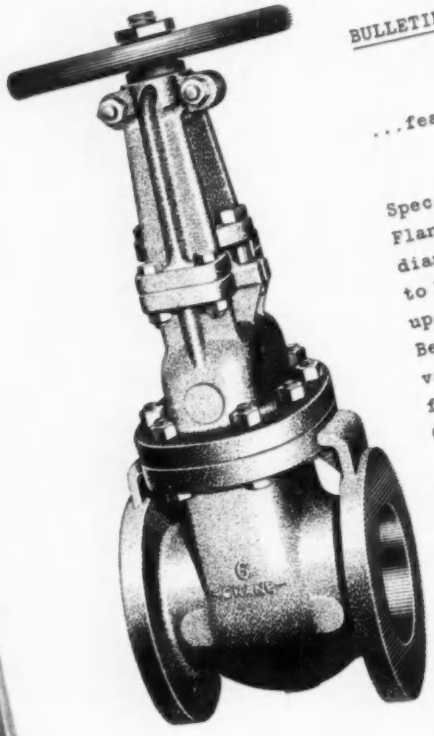

BULLETIN ON CRANE CAST IRON WEDGE GATE VALVES

...featuring this time the F.81

Specification: Bronze trim, rising stem. Flanged British Standard Tables "D" and "E" diameters. Working pressures: saturated steam up to 100 pounds. Water or oil (cold, non-shock) up to 200 pounds.

Besides the F.81. Crane, of course, make innumerable variants of this and other Cast Iron Gate Valves from 2" to 12". All have these features: long Disc Guides which seat Discs properly, minimise drag on seat faces, and prolong valve life. Shoulder type Seat Rings prevent rings from loosening. Two piece Ball-Type Gland prevents binding on stem—even when gland bolt nuts are pulled up unevenly. All are available in bronze trim or all-iron—with screwed or flanged ends (according to size)—with rising or non-rising stem. According to trim they are suitable for use with steam, water oil or gas services.

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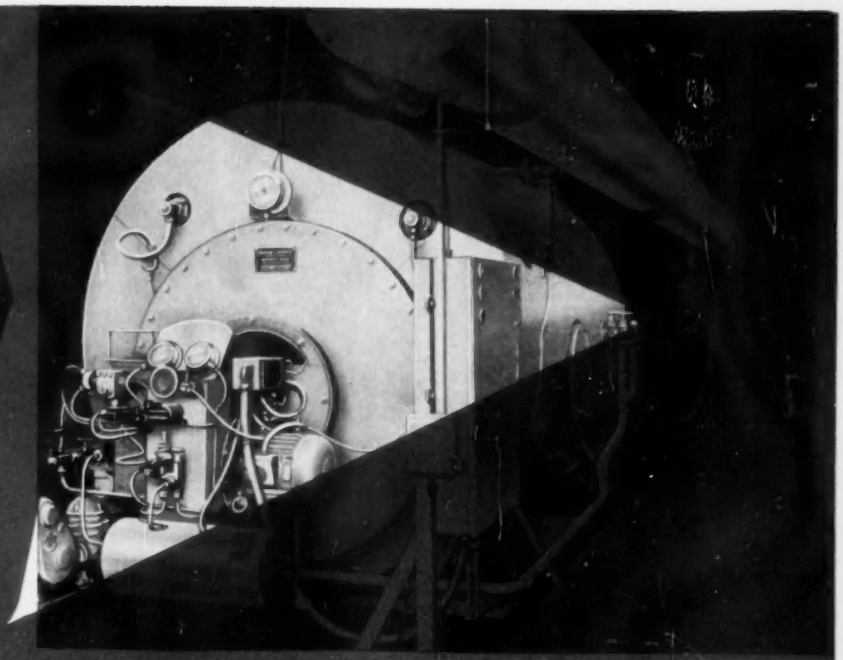

LESS SPACE

Photograph by courtesy of Messrs. Field, Sons & Co. Ltd.

with 33⅓% Increased Output

These 3 single pass packaged oil fired boilers were recently installed WITHOUT INTERRUPTION OF SERVICES to replace an outmoded battery of 10 gas fired boilers.

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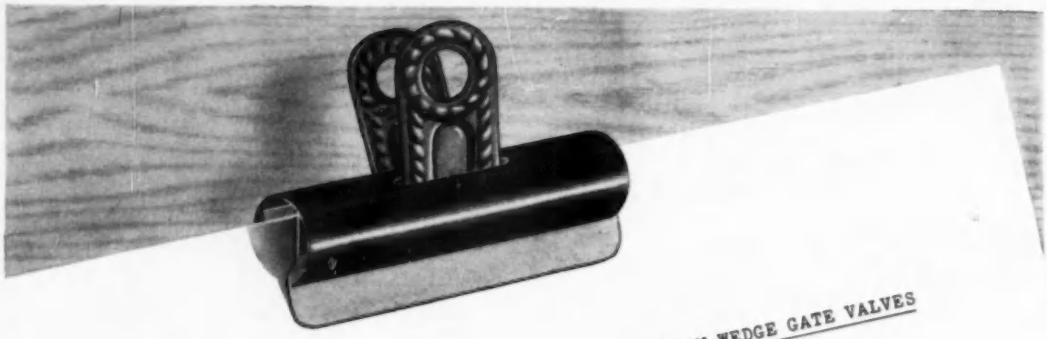

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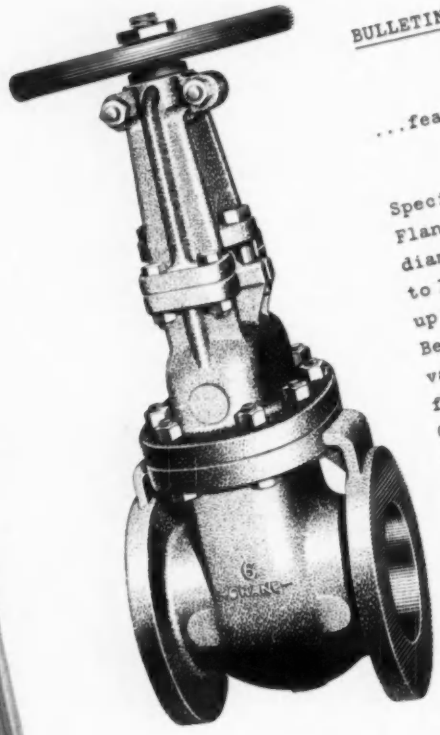

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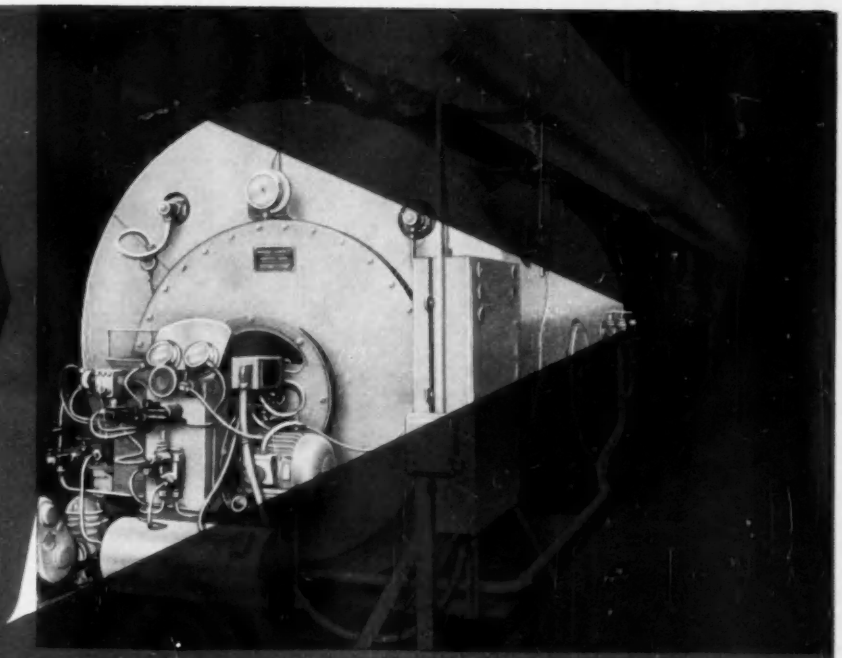

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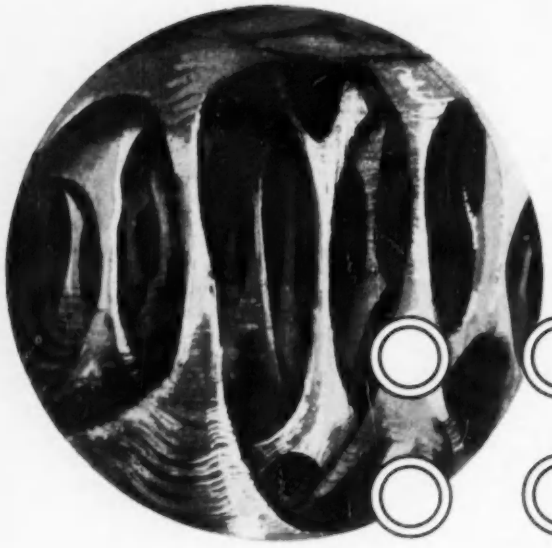

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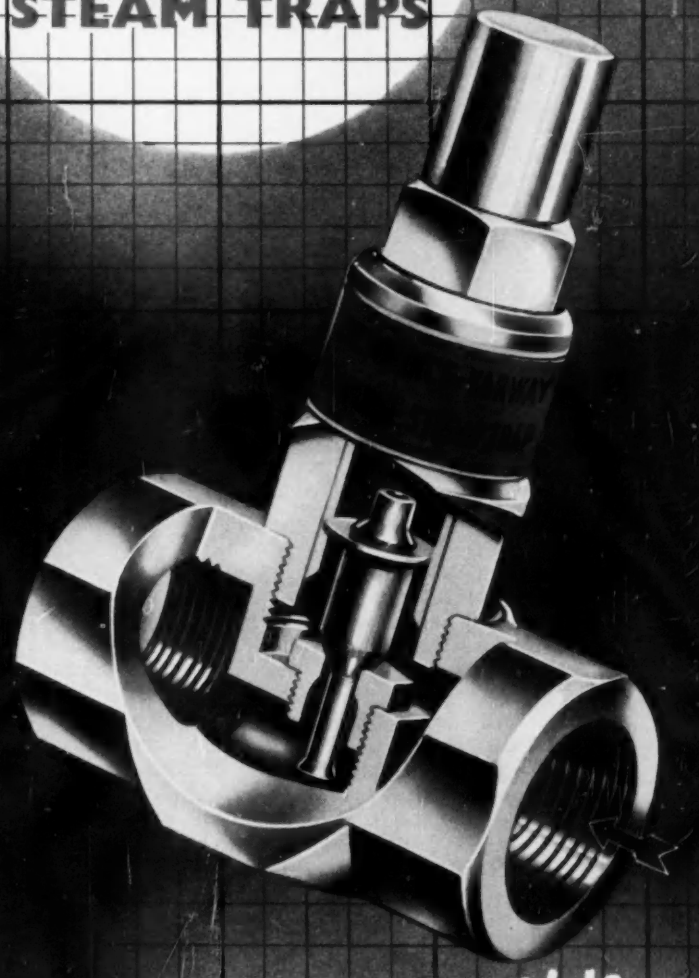

Processes requiring careful temperature control call for Dewrance-Yarway Impulse Steam Traps on Steam equipment. The reason—these Traps maintain even temperatures because there is no arresting of flow or waiting for large quantities of condensate to accumulate. All condensate is discharged as soon as it is formed.

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- Easy to install, easy to maintain.
- Stainless Steel.
- Only one moving part—the valve.
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FUELSLIP is more than a product—it's a comprehensive technical service. Extensive research laboratories back up the careful and individual consideration of each user's particular problems. Results are effected not by a standardised product but by formula modification of that product. Slip Service ensures that *you* make the most of the fuel that *you* burn.

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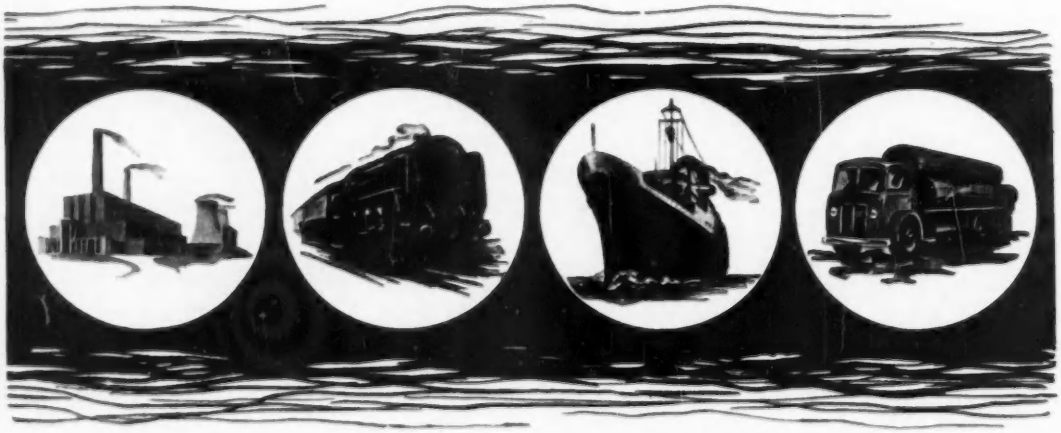

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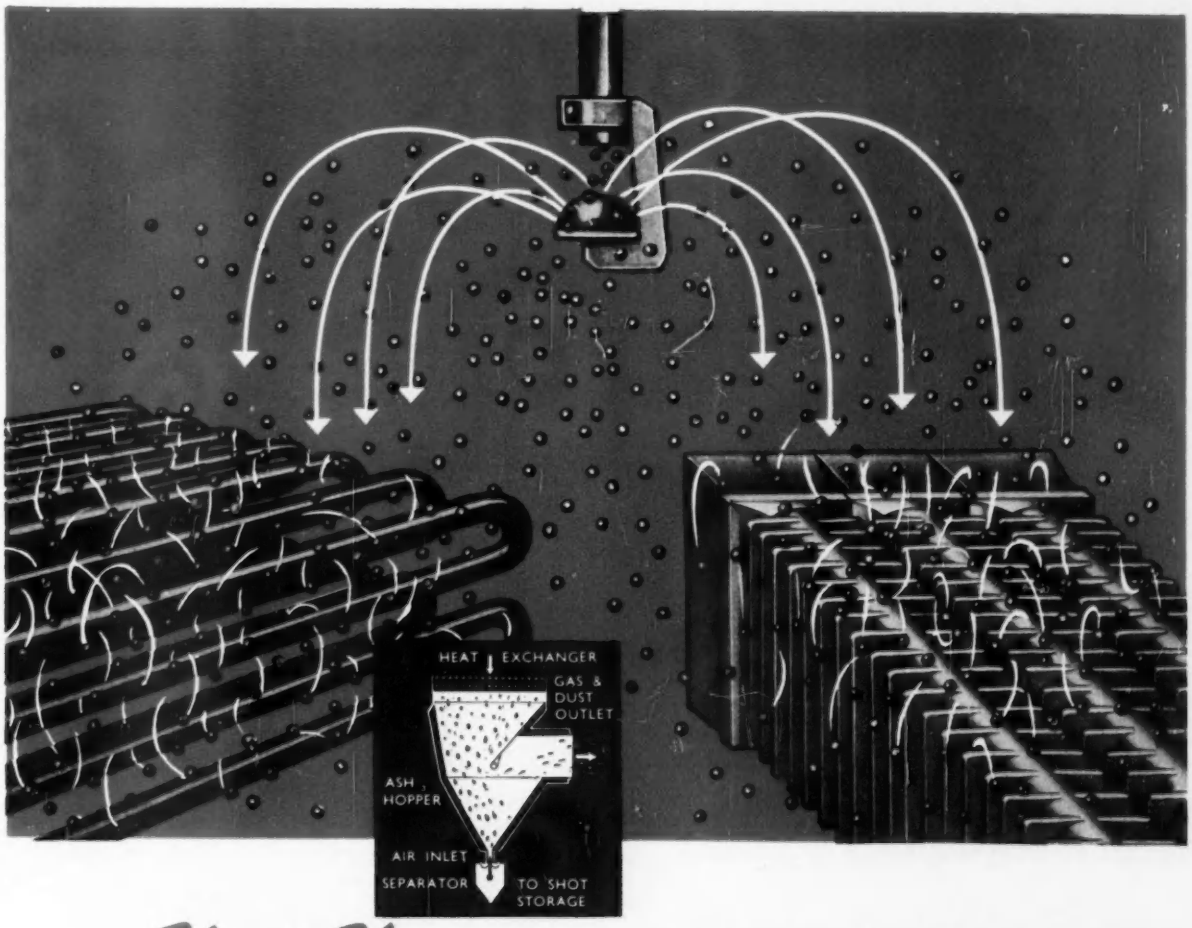

Shot Cleaning maintains constant temperature in heat exchangers at all times

GET MAXIMUM EFFICIENCY from new heat exchangers; recover lost power from old. Install the KEITH BLACKMAN-BROMAN EKSTROM SHOT CLEANING SYSTEM which, irrespective of fuel (coal, oil, waste heat, sulphite, sulphate liquor or creosote pitch), offers many indisputable advantages:

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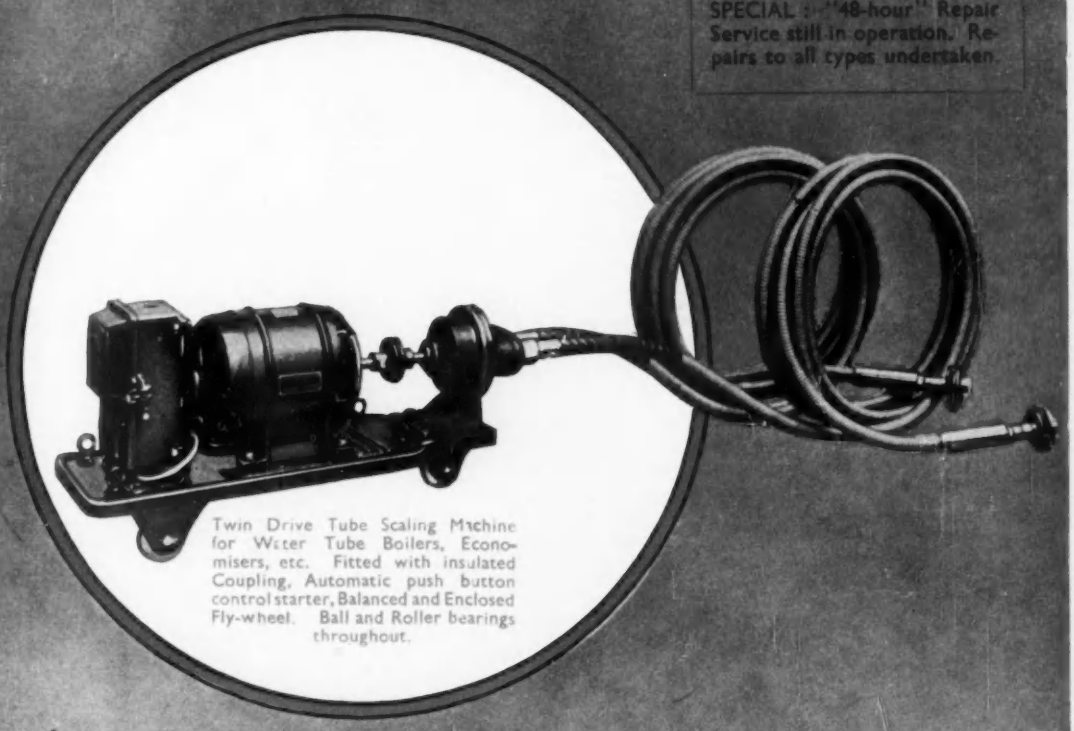

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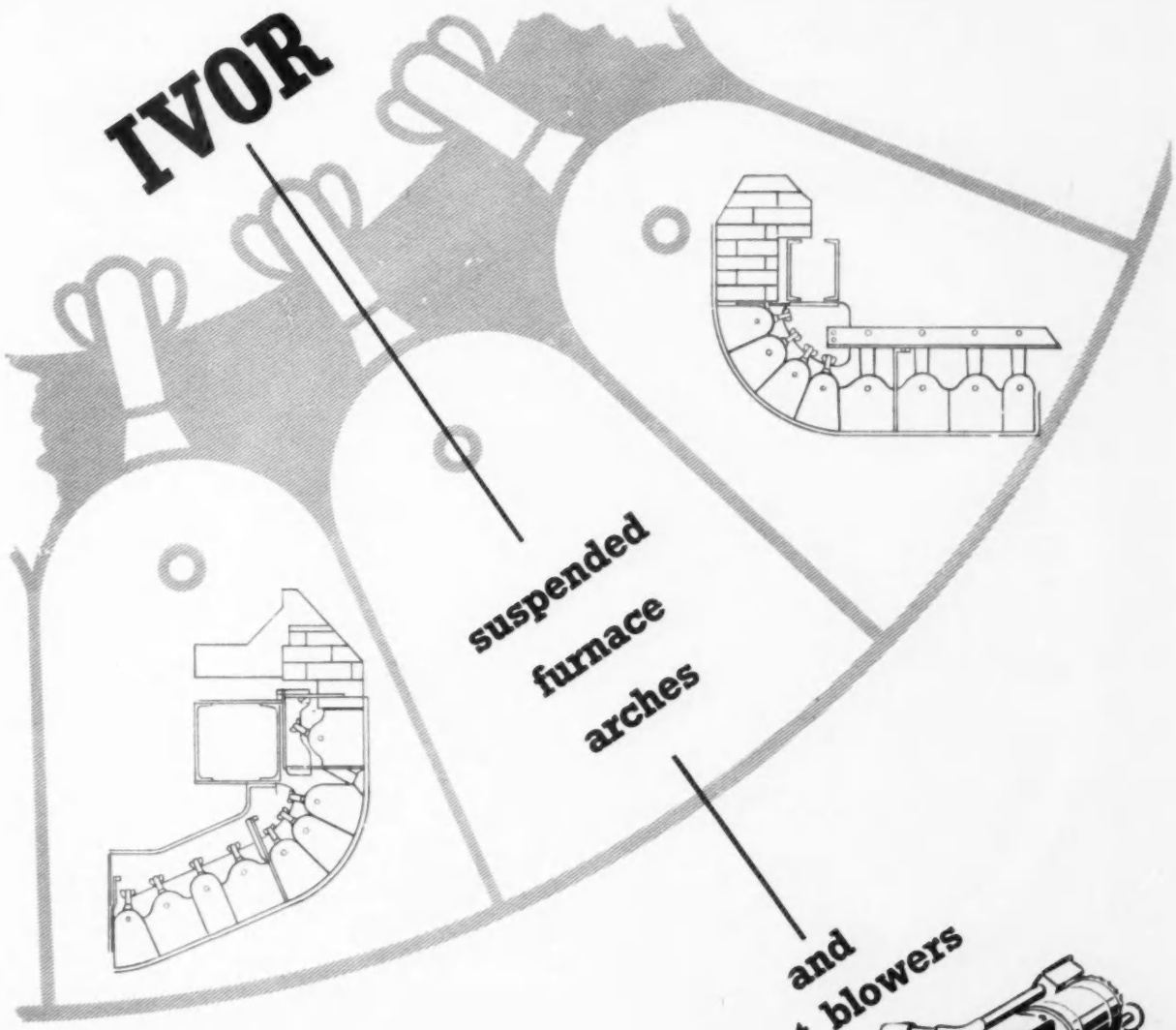

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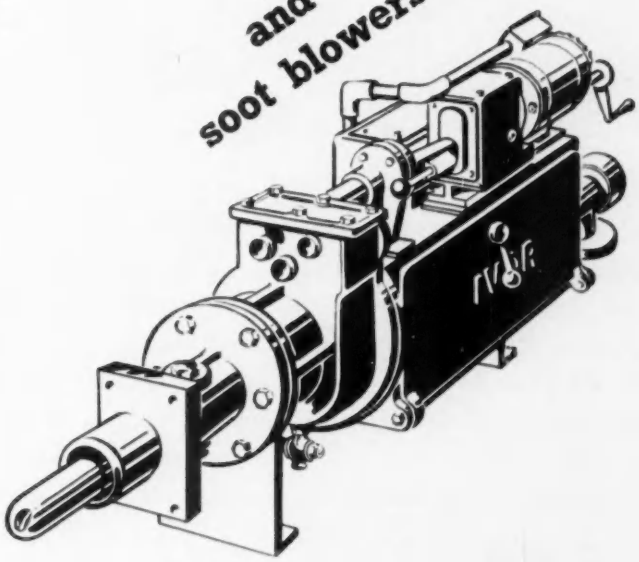

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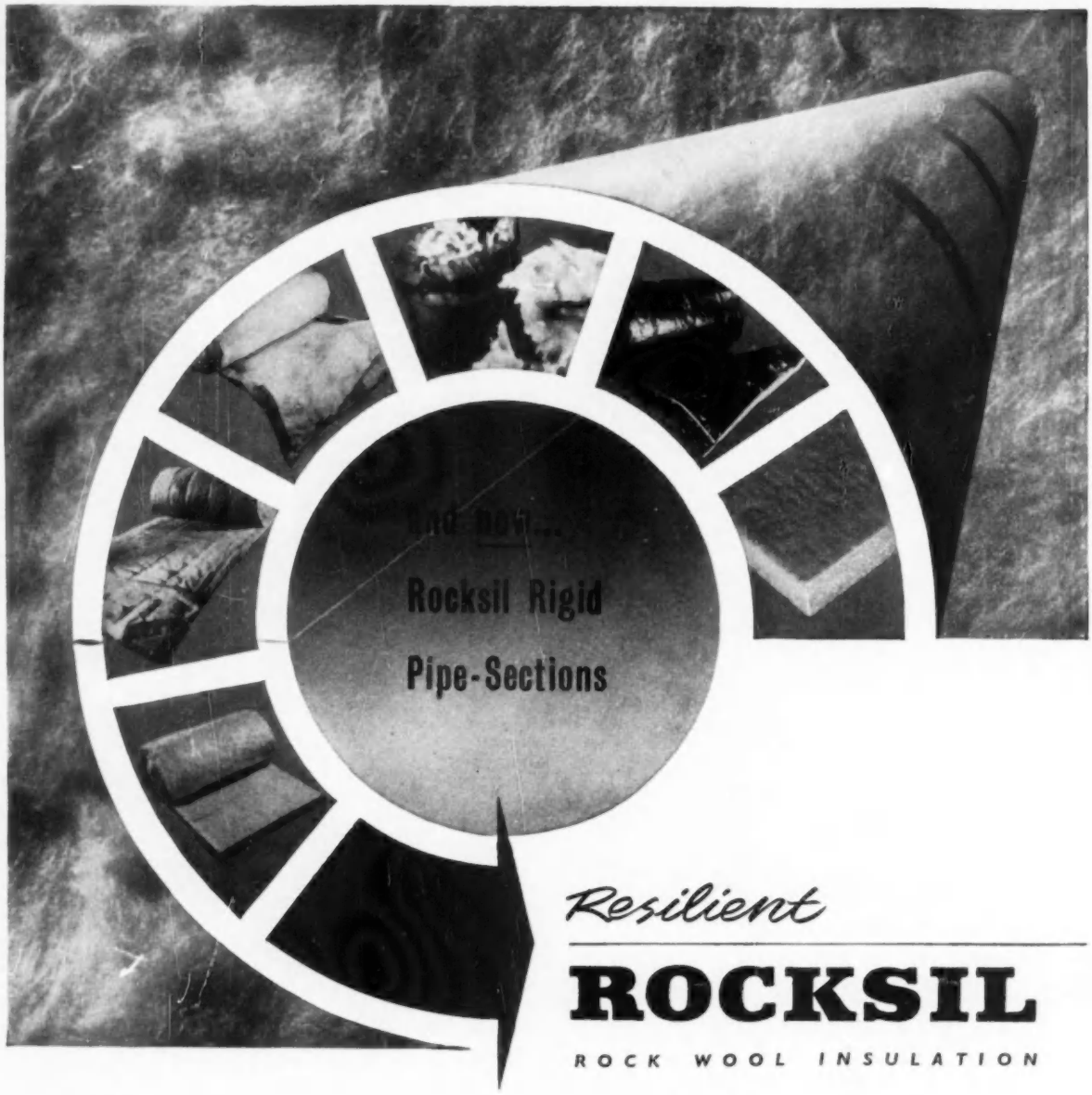

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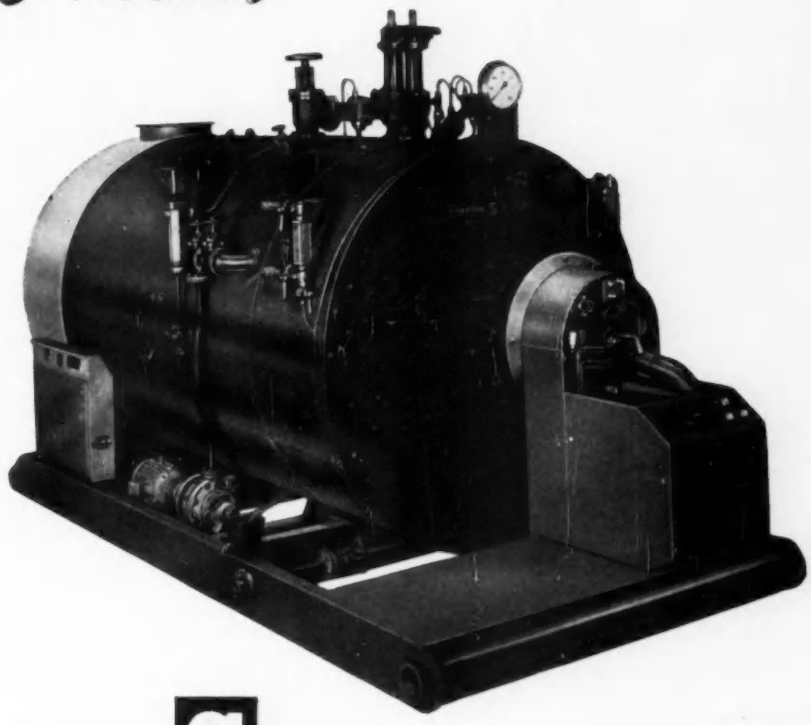

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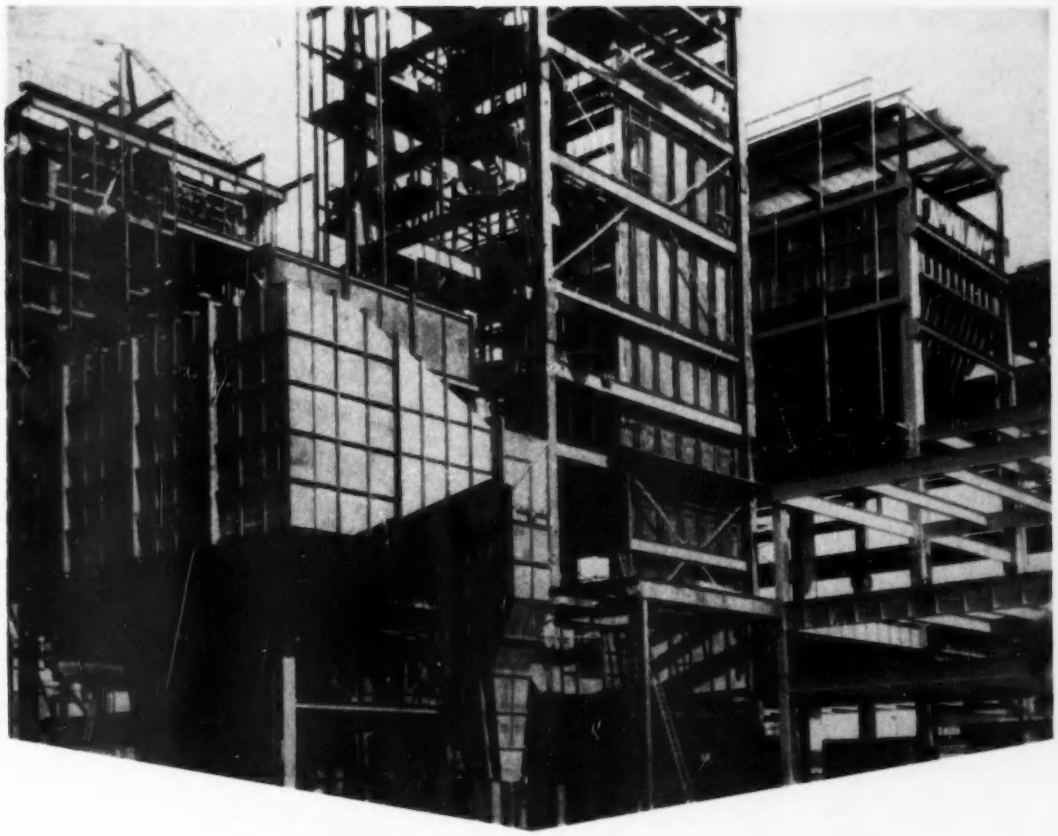


BOILERS UNDER CONSTRUCTION

at

LITTLE BARFORD 'B'

by

FOSTER WHEELER

for the

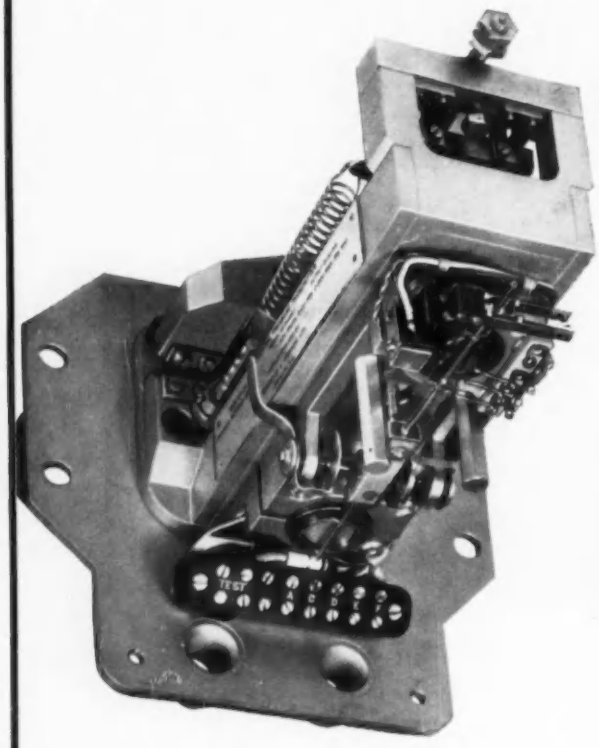
CENTRAL ELECTRICITY GENERATING BOARD

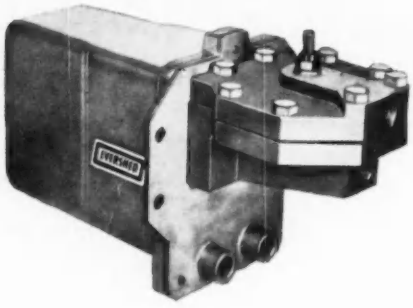
Illustration shows outdoor installation of two P.F. boilers at Little Barford "B" Power Station. Each boiler 550,000 lb/hr; 950 psig; 925° F.

FOSTER WHEELER LIMITED

FOSTER WHEELER HOUSE, 3 IXWORTH PLACE, LONDON S.W.3.

Control flow with confidence by using EVERSHED FLOW TRANSMITTER





The ER.125 is not only designed for the accurate measurement and control of flow or differential pressures, but also to give reliable service under the most exacting conditions. Suitable for oil, viscous or corrosive fluids, water, steam or gases,

the ER.125 can be supplied with:

Ranges 0–5″ to 0–50″ W.G.
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Maximum working pressures 1,000 p.s.i.

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Output current proportional to flow or differential pressures:
0–15 milliamps D.C.
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This transmitter is intrinsically safe for petroleum vapours and hydrogen.

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The most versatile steam trap yet

Unaffected by superheat, waterhammer, vibration, corrosive condensate and freezing

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Works in any position

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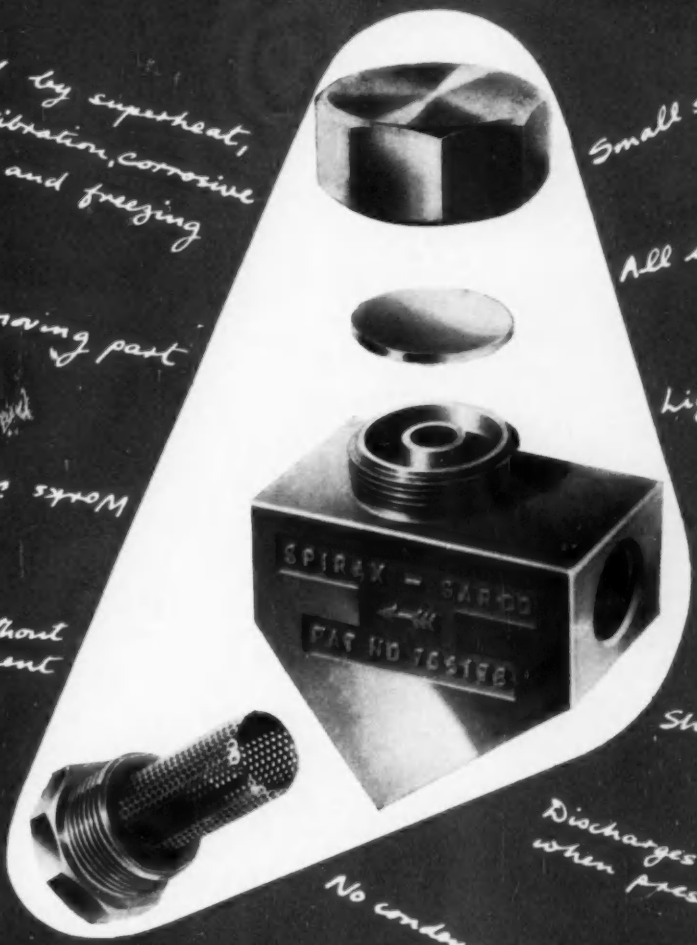
Built-in stainless steel strainer



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All stainless steel

Light weight

Up to 550°F.

Shuts tight on no load

Discharges condensate when present

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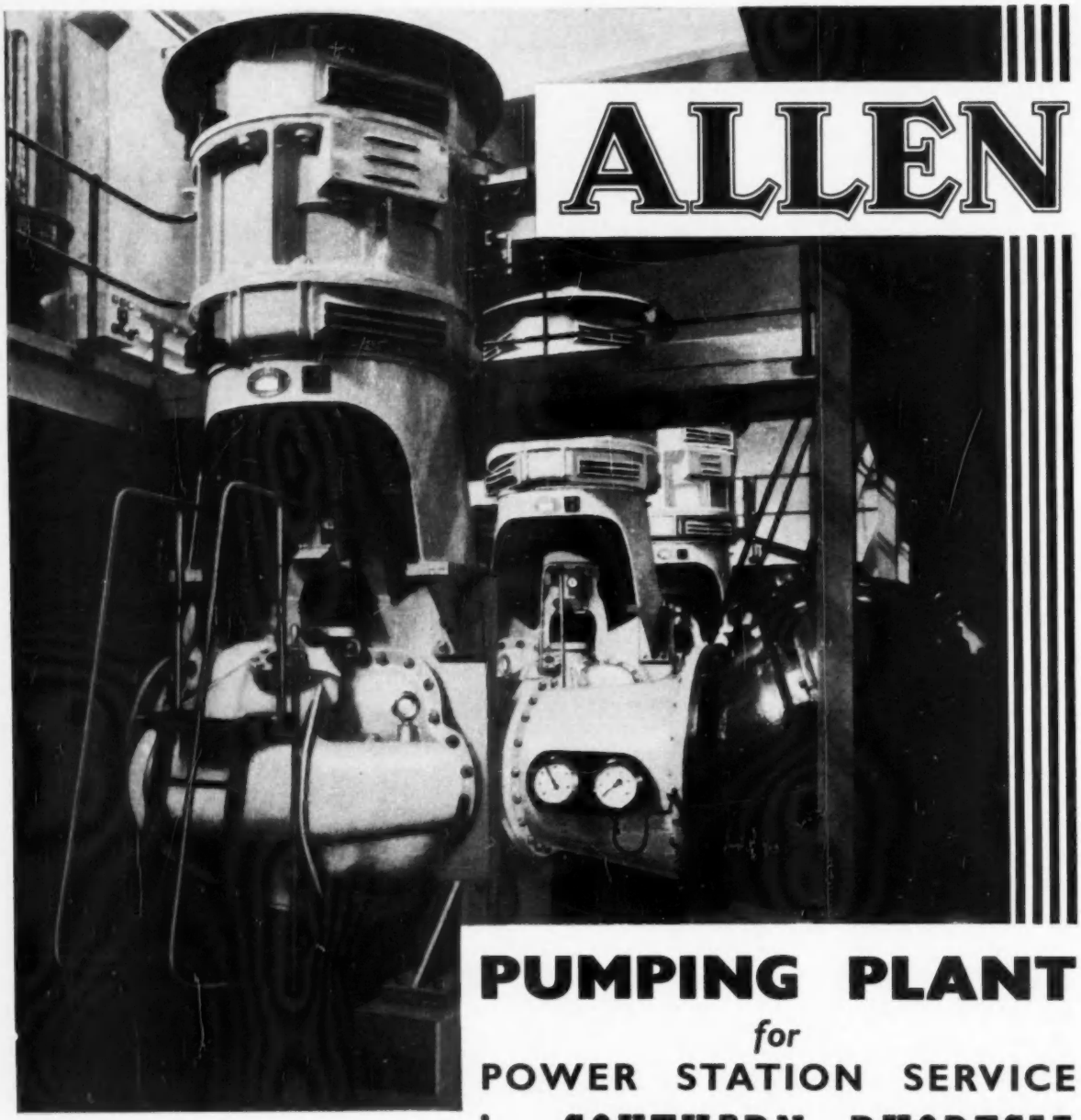

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Each pump is designed for a capacity of 24,000 gallons of water per minute against a total head of 60 feet, and is driven by a 550-h.p. M-V motor running at a speed of 590 r.p.m.

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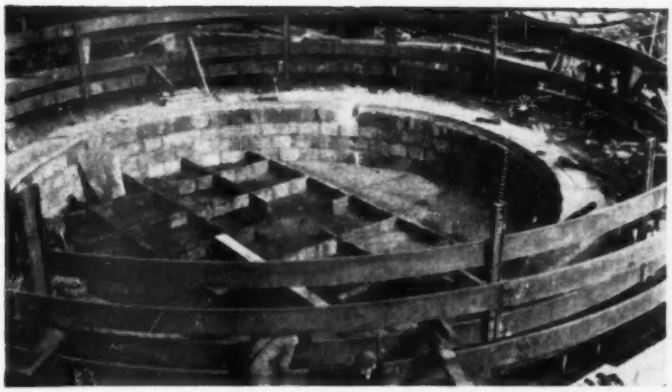

Foundation for a blast furnace in Refractory Concrete, cast as a cylindrical boss of 32 ft. 6 in. diameter and 9 ft. depth.

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to ensure maximum protection to the underlying structural foundations

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USE SECAR 250
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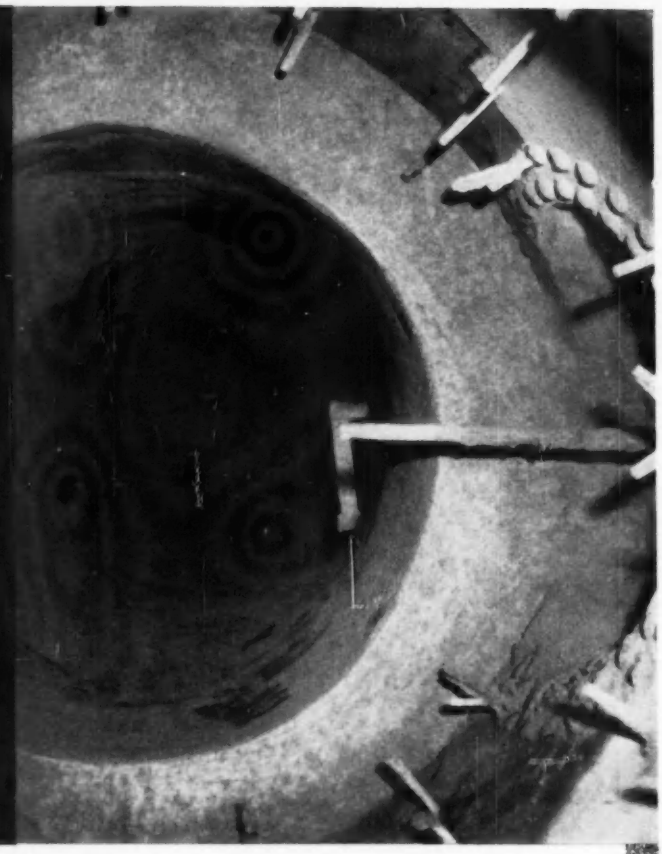

Bustle main of Queen Victoria Blast Furnace showing 'gunned' lining in Tri-Mor Dense 'Guncrete'. (Inside diameter of shell 5 feet. Thickness of 'Guncrete' lining 9 inches).
Photograph by courtesy of the Appleby-Frodingham Steel Co. (Branch of the United Steel Companies Ltd.).

TRI-MOR GRADES

TRI-MOR *Standard Castable*

A medium texture refractory having negligible shrinkage up to 1,350° C. Suitable for casting special shapes or for monolithic structures. Limiting service temperature 1,350° C.

TRI-MOR *High Strength Castable*

A similar refractory to Tri-Mor Standard Castable, but specially developed to have very high mechanical strength over the lower temperature range. Maximum service temperature 1,250° C.

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Suitable for face temperatures up to 1,600° C; has an extremely high resistance to thermal shock; used for cast in situ monolithic structures and for pre-cast refractory shapes; can be applied with a cement gun.

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A plastic refractory for use up to 1,650° C: low shrinkage and a high resistance to spalling. Supplied mixed to the correct consistency for installation.

TRI-MOR *Dense "Guncrete"*

A hydraulic setting refractory with a maximum service temperature of 1,300° C. It has a high resistance to abrasion. Designed for application by cement gun, but can be trowelled.

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TRI-MOR *Insulating "Guncrete"*

Similar to Tri-Mor Insulating Castable but for application by cement gun.

Full details of each grade are available on request.

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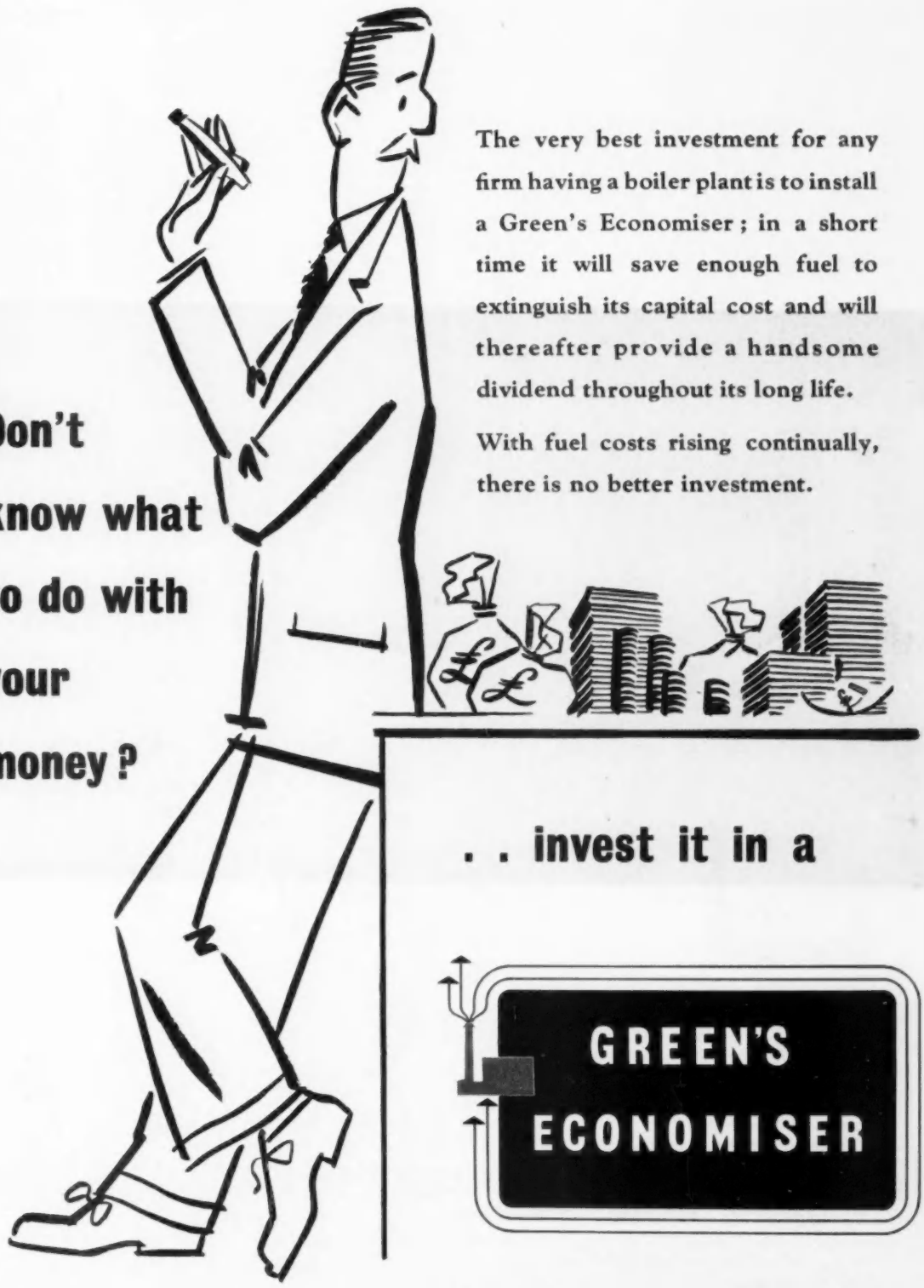

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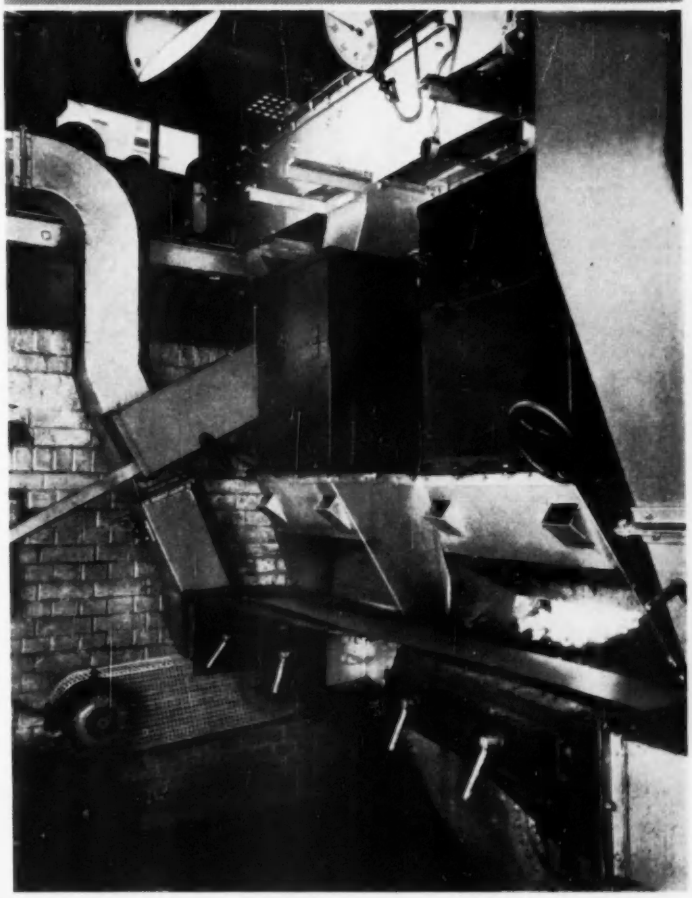
This Gravity Feed Stoker . . .

. . . has recently been installed at **Guy's Hospital, London** where it replaces our Standard Stoker which had been in use for 25 years.



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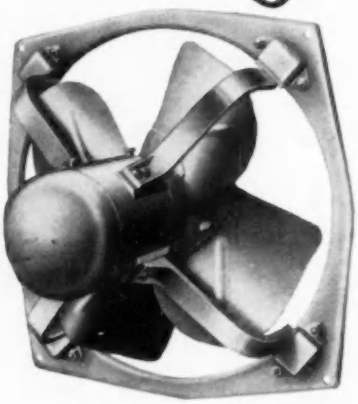

The quality of engineering in WOODS propeller fans means lasting reliability and economy from long service. Remember, WOODS are the world's most widely used fans, chosen internationally for performance and quality.

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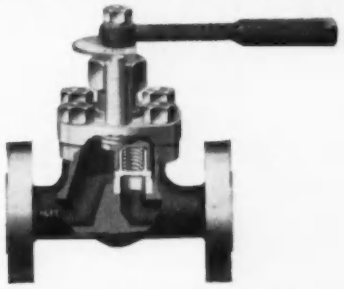
UNIFLOW VALVES



Small forged steel valves of the highest dependability. Ideal for controlling high pressure superheated steam, drain services etc. Easy access for maintenance; seat can be reground without removing valve from pipeline. Available for steam pressures up to 2,800 lb/sq. in.

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Details of high pressure couplings and valves will be sent on request.

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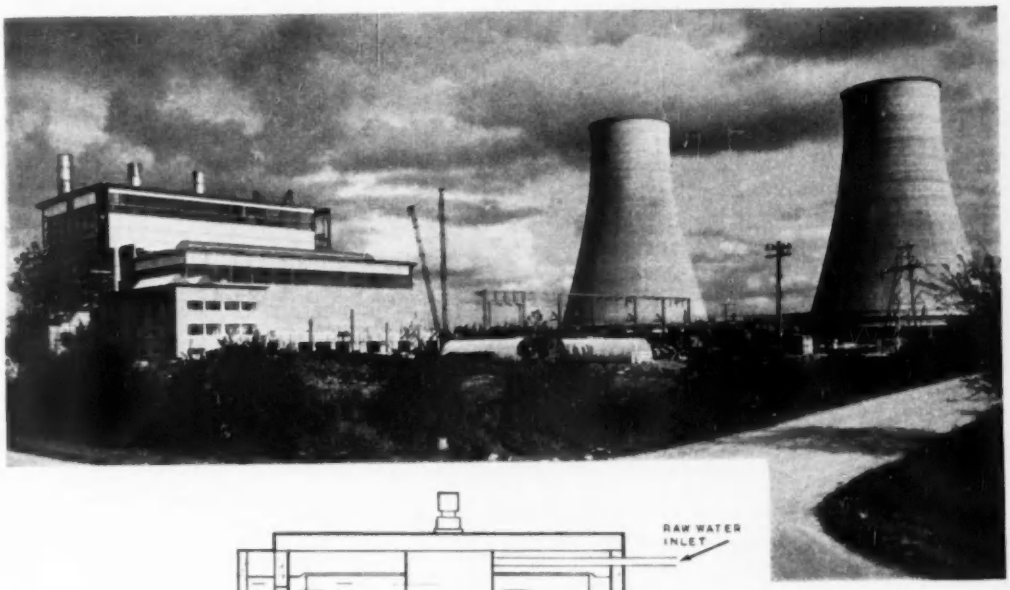

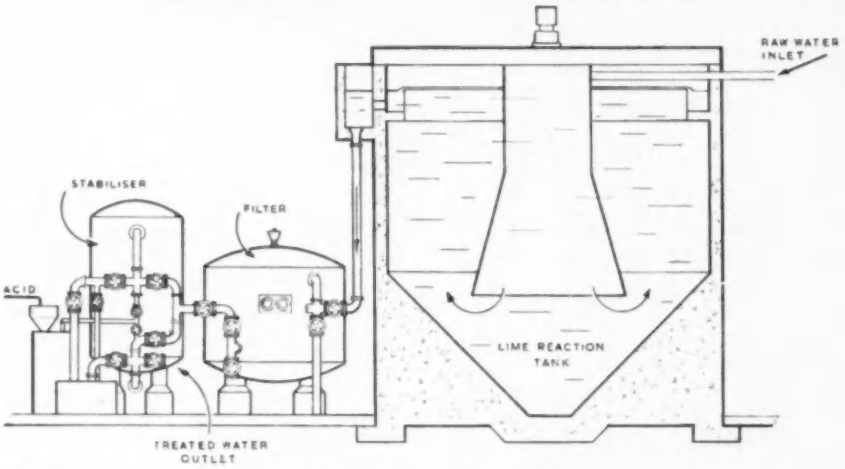

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AUTOMATIC STABILISATION

The lime/stabilisation plant illustrated ensures, automatically, the stability of a water of varying quality softened by lime. Subsequently, the residual hardness of the stabilised water is reduced to zero for evaporator make-up.

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"Let's tackle this problem once and for all,"

SAID THE CHAIRMAN

"We're agreed 'clean air' is here to stay but is this the best way to achieve it?"

"It's not the cheapest—in terms of initial cost at any rate."

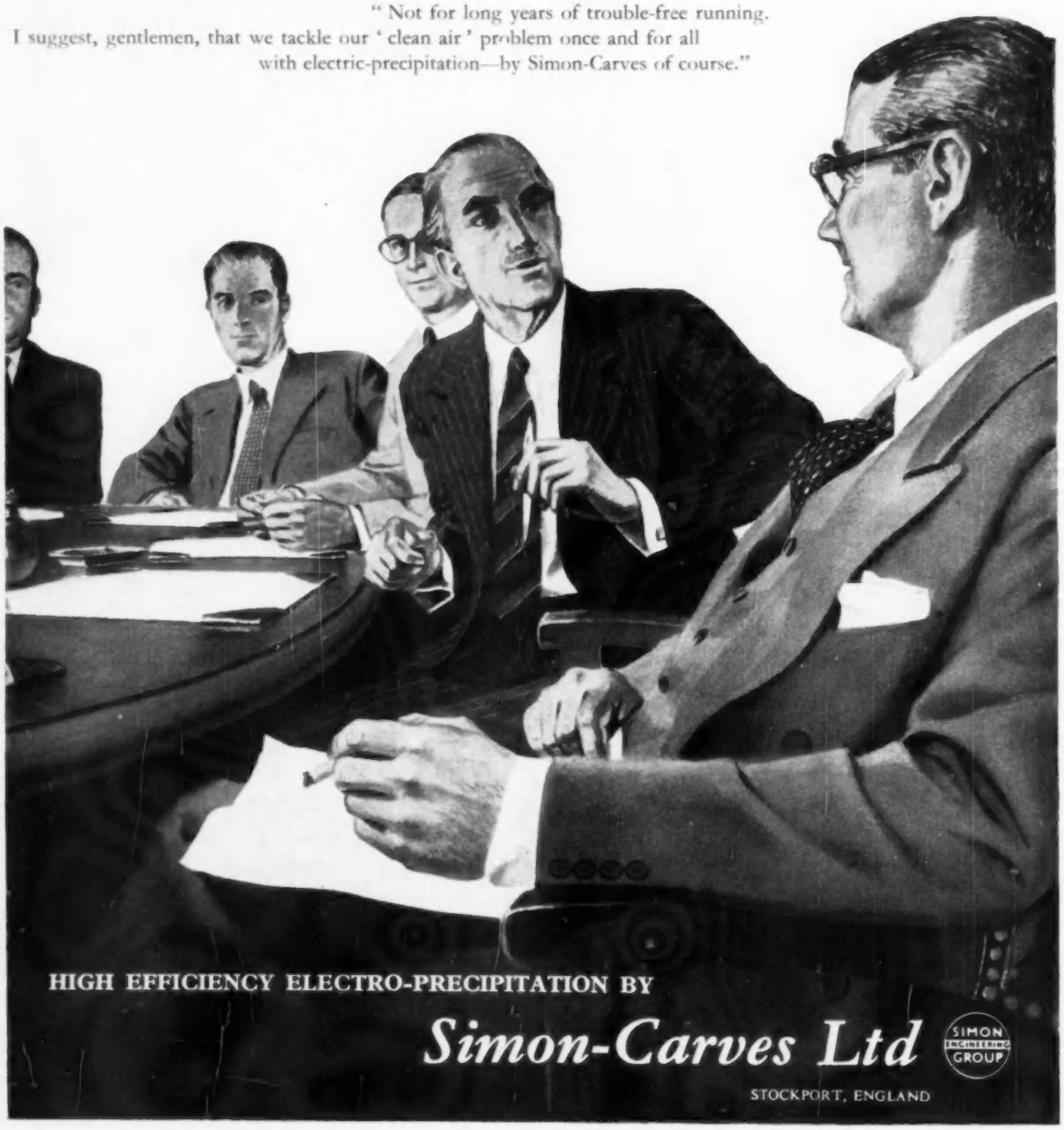
"But can we afford to settle for anything cheaper?"

"Afford to? I don't quite follow you."

"I am thinking in terms of power costs, running costs and so on.
You know how maintenance and repairs can run away with the money."

"It still seems a high price to pay."

"Not for long years of trouble-free running.
I suggest, gentlemen, that we tackle our 'clean air' problem once and for all
with electric-precipitation—by Simon-Carves of course."



HIGH EFFICIENCY ELECTRO-PRECIPITATION BY

Simon-Carves Ltd

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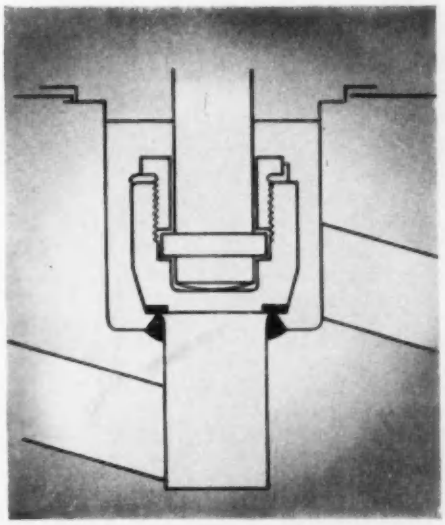
REDUCE MAINTENANCE COSTS BY INSTALLING VALVES FITTED WITH

"HARD FACED"

SEATS AND VALVE HEADS

These Valves are giving long trouble-free service in land, marine and naval installations



"STELLITE" HARD FACING POSITIVELY PREVENTS LEAKAGE

The seat, shown opposite, is an integral welded "HARD FACE" deposit, accurately machined. The valve head is similarly deposited.

THE RESULTANT SEAL

(a) Offers utmost dependability to meet severe conditions,
(b) is tough and hard,
(c) is erosion and corrosion resistant, and
(d) eliminates seat replacements.

"HARD FACED" VALVES can be supplied ranging from ¼ in. bore, for pressures from 600 lb./sq. in. upwards, and temperatures up to 950 deg. F.

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He would have the hump if you mentioned it

But someone should have told him. Corrosion in boilers and steam-raising plant should be a thing of the past—but still there are those who do not Apexiorise. For over 50 years leading boiler manufacturers have specified "Apexior Number 1"—the *economical* safeguard against corrosion, where wet temperatures of 175° to 1000°F. are met. *Certain* protection for at least 12 months is assured with a double coat of "Apexior Number 1". After the initial treatment only one coat is necessary. Scale too provides no danger as it does not adhere firmly to Apexiorised surfaces; there is less of it and it is more easily removed.

In certain industries it is a most important advantage of "Apexior" that it does not affect water by taste, taint or smell. Make sure that you know all about "Apexior" and send for your copy of the "Apexior Manual".

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But for cold-wet surfaces up to 125°F.—use "APEXIOR NUMBER 3"

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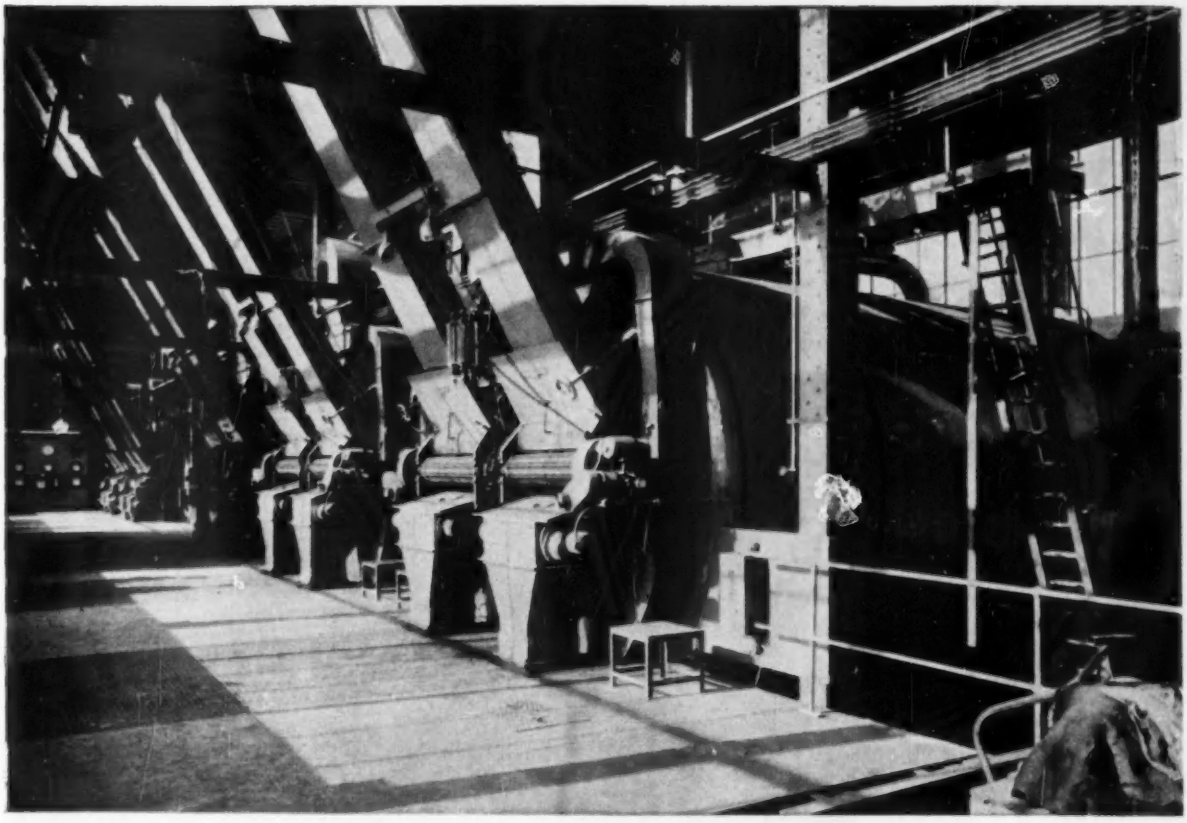
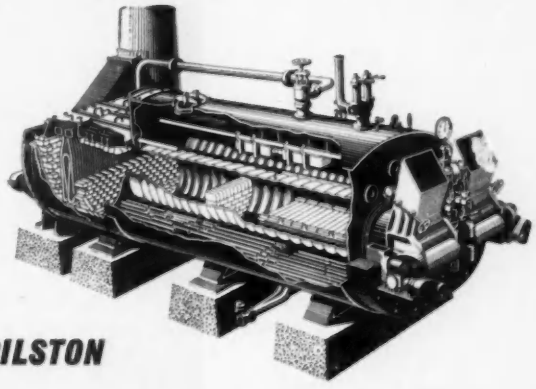


JOHN THOMPSON SUPER ECONOMIC BOILERS

at

JOSEPH SANKEY & SONS LTD · BILSTON



The new boiler plant at Joseph Sankey and Sons Ltd., Bilston, has five John Thompson Super Economic boilers, stoker fired. Three of the boilers each have an evaporation of 15,000 lb/hour and the remaining two 10,000 lb/hour, working pressure 120 lb/sq in The larger boilers are equipped with superheaters. Mechanically operated ash extractors are fitted to the Thompson-Triumph stoker, the ash then passing to the John Thompson submerged-belt ash conveyor. Equipment manufactured and erected by members of the John Thompson Group of Companies included boilers, stokers, chimneys, feed tanks, coal and ash handling plant, pipework, walkways, ladders and windows, instruments and panels, ducting, superheaters and feed water treatment plant. Consultants for this instaliation were Messrs. Powell Duffryn Technical Services Ltd.

JOHN THOMPSON (WOLVERHAMPTON) LIMITED · JOHN THOMPSON GROUP

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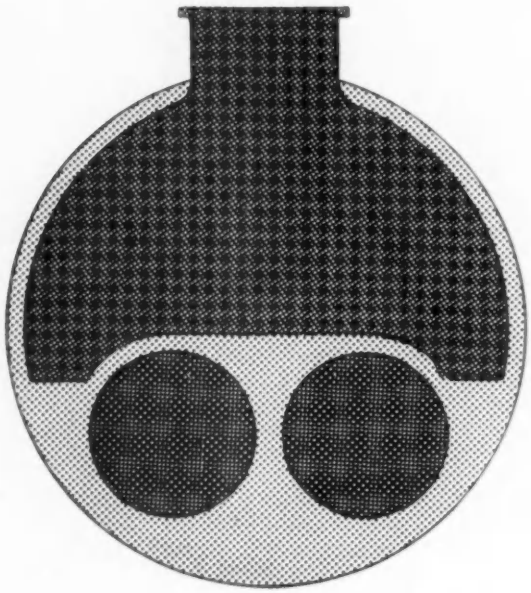
The Richardsons Westgarth Economic Boiler

Among shell boilers the Economic design holds pride of place. It has a high thermal efficiency, is flexible, requires only the simplest ancillary equipment, may be fired with an immense variety of fuels . . . these and others are merits of Economic boilers as a class.

The Richardsons Westgarth Economic boiler is simply an economic boiler made with the attention to detail that ensures a long and trouble-free life; and that by a company with immense experience of steam-raising plant of all kinds. Naturally, it meets the requirements of the relevant British Standard Specifications and of the Insurance companies.

The range extends from 3,000 to 20,000 lbs/hour. Up to 10,000 lbs/hour boilers may be either rivetted or welded; above this capacity all boilers are rivetted.



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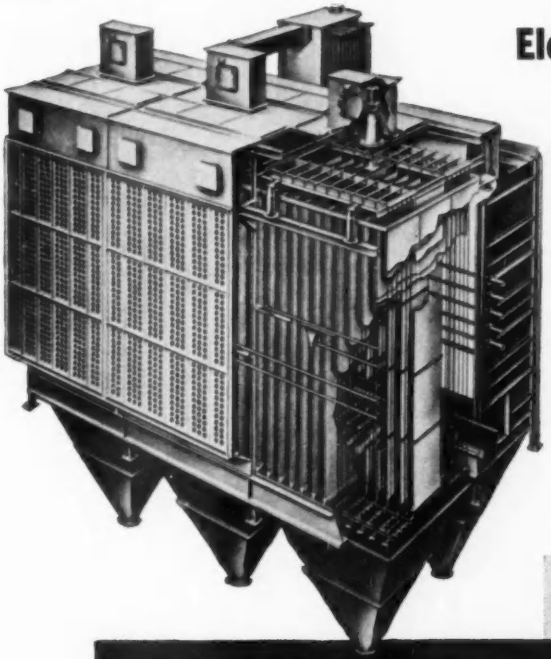
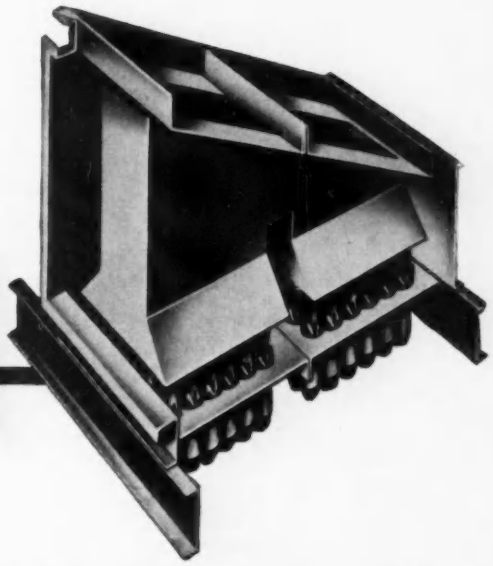


Electrostatic Precipitators

Made under licence from the Aerotec Corpn., U.S.A., these precipitators have an extremely high collection efficiency, low current consumption and many novel design features including screen-grid type collecting electrodes which minimise re-entrainment and consequent emission of dust. Manufactured in several combinations of width, height and length to suit available space in existing plants or most efficient usage of building volume in new constructions.

PD–KB



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Here is a dust collector which satisfies the ideal requirements of steam generator designers. It has a high collection efficiency at moderate resistance; maximum freedom from dust erosion; accessibility for maintenance and service; simple, low cost erection; flexibility of arrangement to meet space availability conditions. These collectors can be used in series with electrostatic precipitators and can be designed to match the precipitator inlet.

Induced & Forced Draught and Grit Arresting Fans

The product of over 75 years of experience, 'Tornado' induced and forced draught fans can handle any boiler draught requirements efficiently and reliably. The type A.R. aerofoil section backward bladed centrifugal fan, with peak efficiency of 90%, is only one of the many types (another is the combined induced draught and grit arrester) produced to deal with all classes of boilers from central heating to those in the largest power stations.

for CLEAN AIR

KEITH BLACKMAN LTD
(Incorporating Blackman Export Co Ltd)
MILL MEAD ROAD · LONDON N.17
in collaboration with Prat-Daniels (Stroud) Ltd., Whitecroft, Nailsworth, Gloucester

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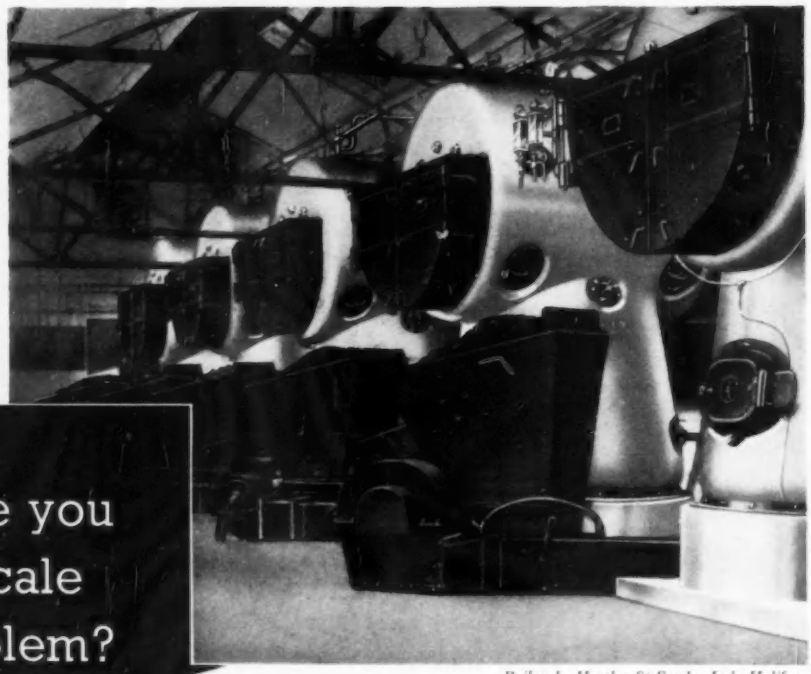

Boilers by Hartley & Sugden Ltd., Halifax.

* Have you a scale problem?

A section of Copper piping showing heavy scale deposit.

The same section after treatment with Starit.

Scale deposits on the interior of a boiler impose stresses in the metal and seriously impair the transfer of heat from the fuel to the water with the efficiency so vital for economical steam raising. Starit Solution effectively removes most types of scale from boilers, cleaning those awkward corners impossible to reach by hand and leaving the metal in a first class conducting state. The unique formulation of Starit ensures rapid attack on the scale whilst its action on the boiler plate is inhibited.

As there are certain cases where the scale is not susceptible to chemical attack we invite you to send us a sample, so that we can determine whether Starit is suitable for your particular problem. We also supply, on request, an informative booklet dealing with the many uses of Starit and the methods of applying it.

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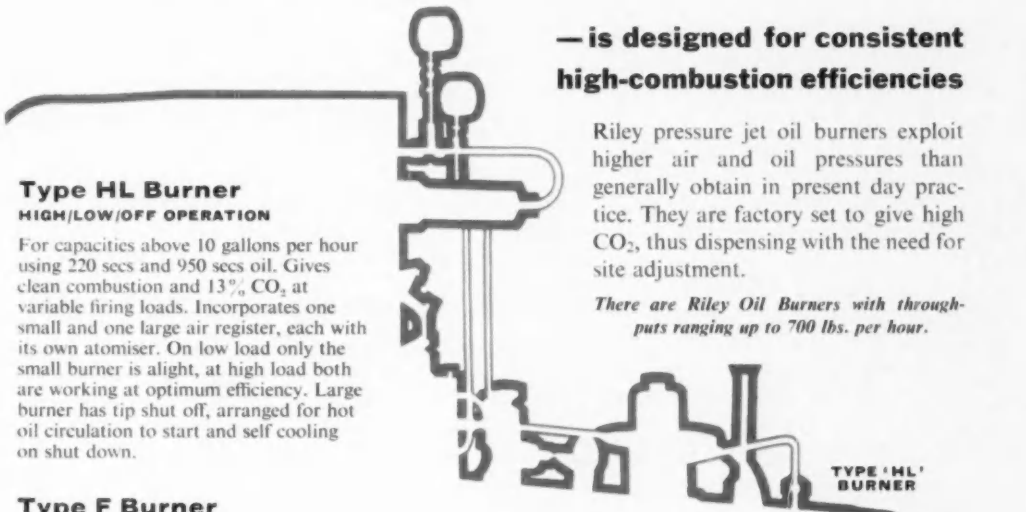

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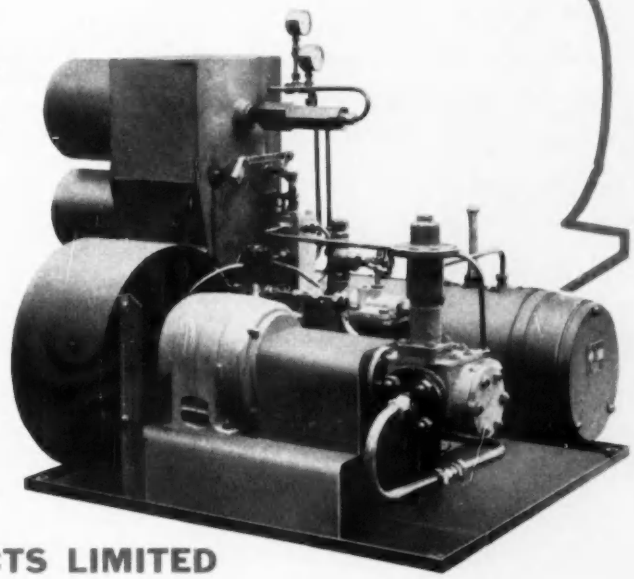

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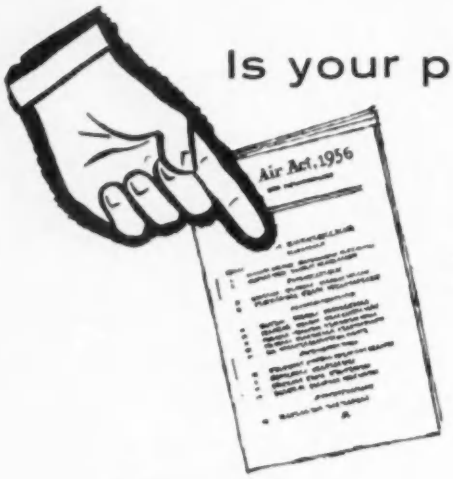

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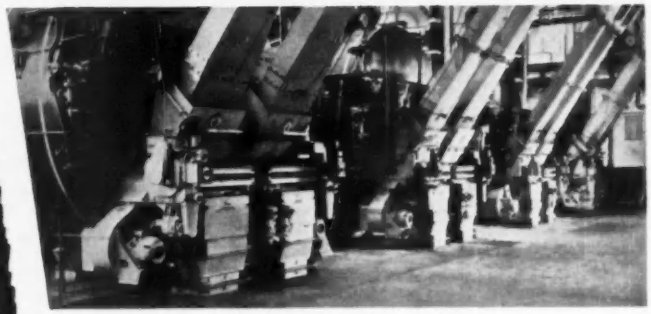

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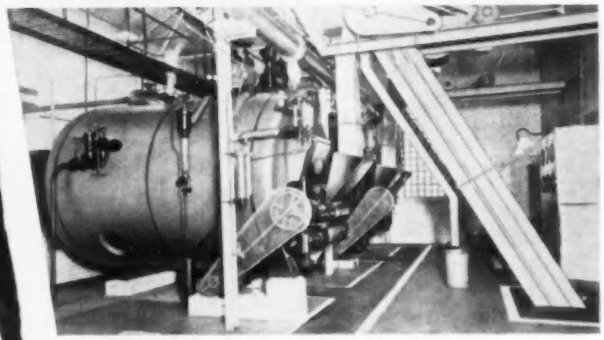

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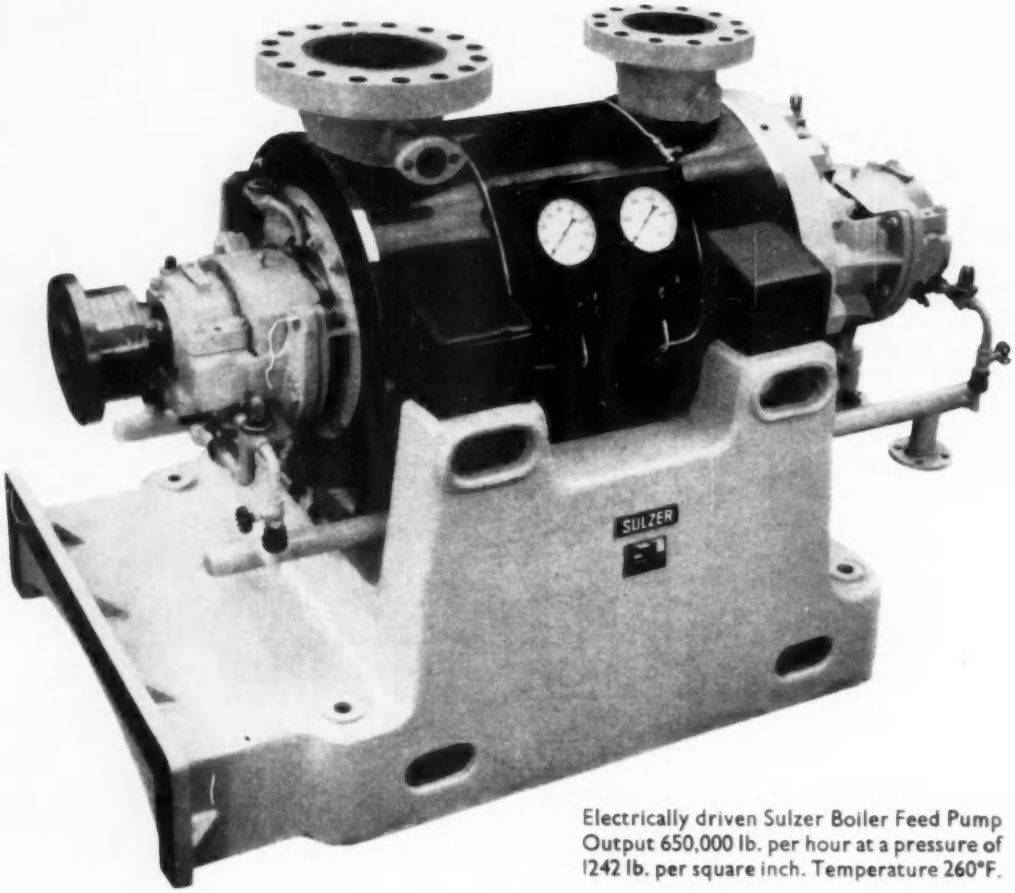

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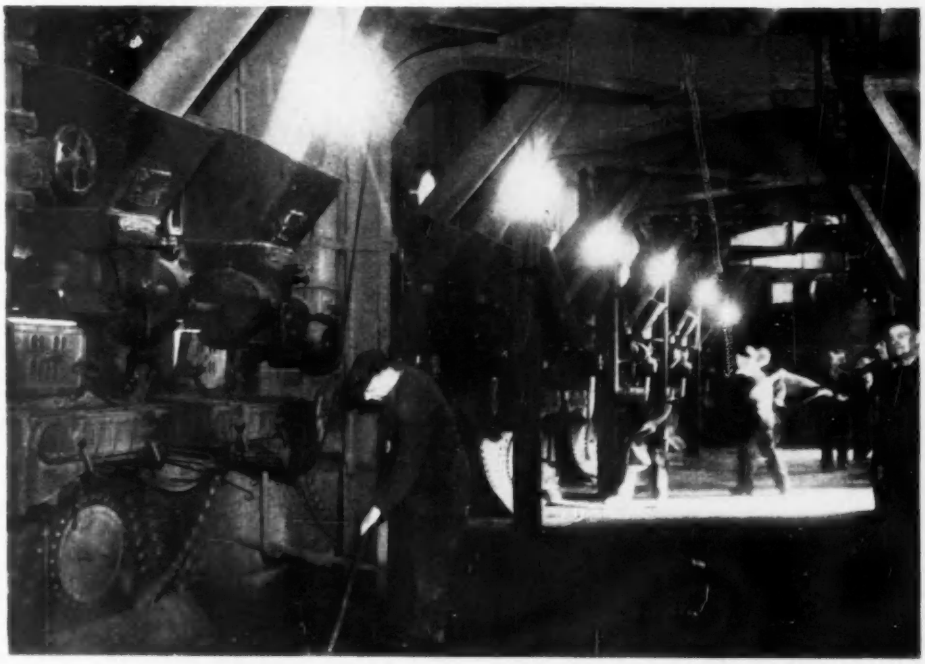

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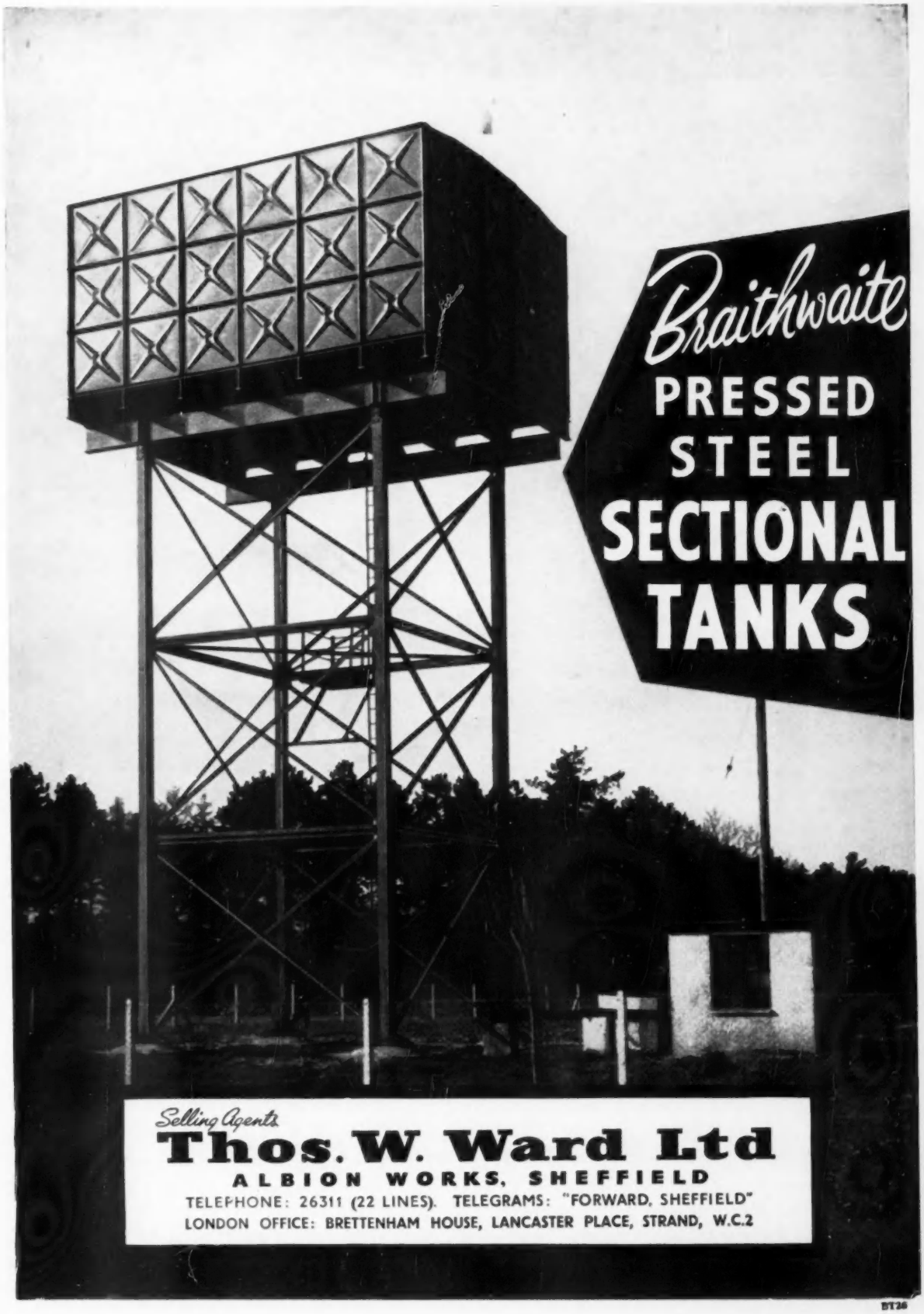

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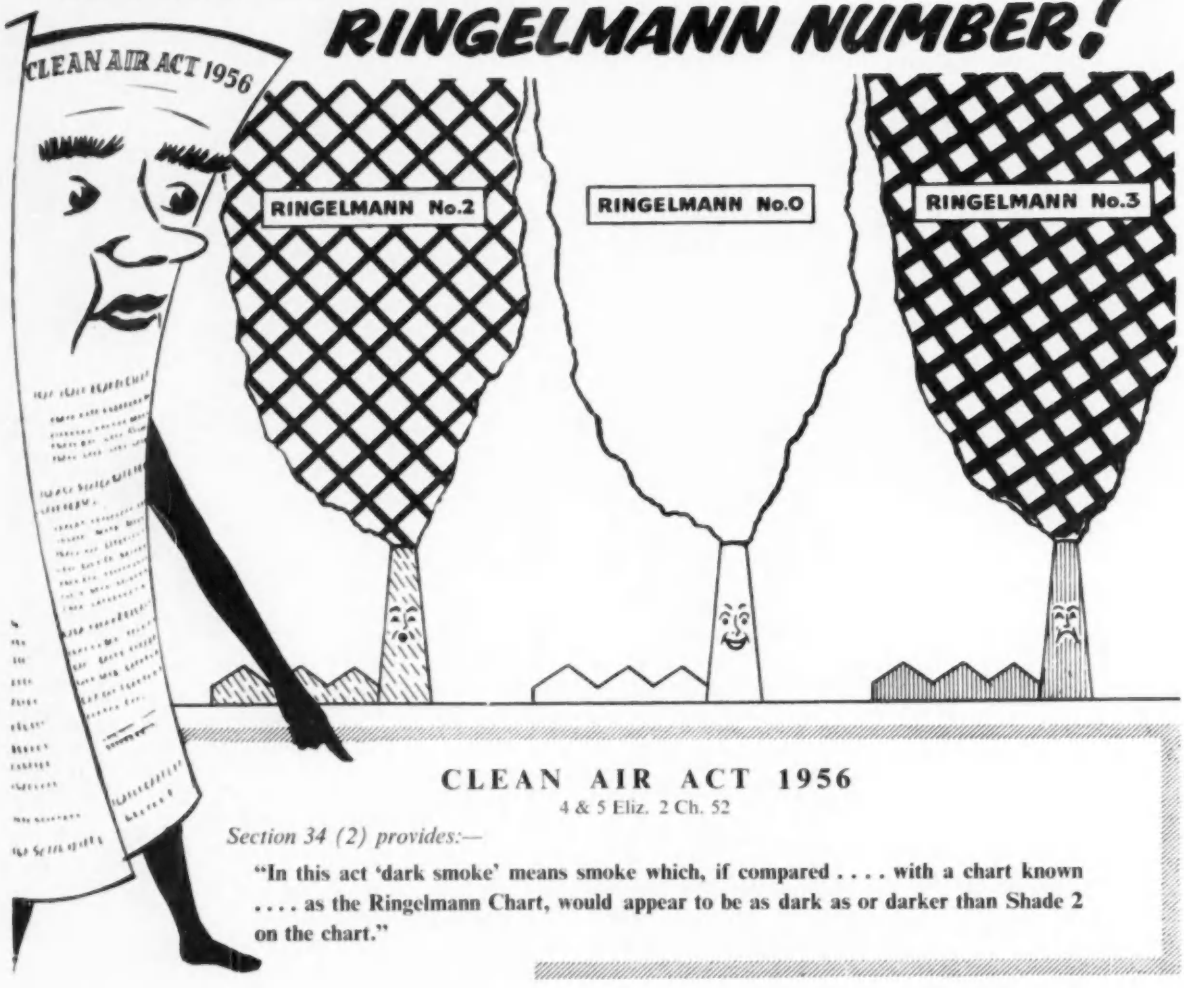

CLEAN AIR ACT 1956

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THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

JANUARY 1959

VOLUME 74. No. 1

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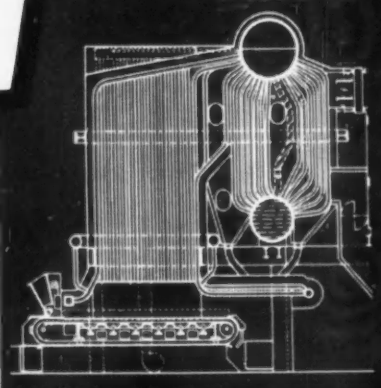
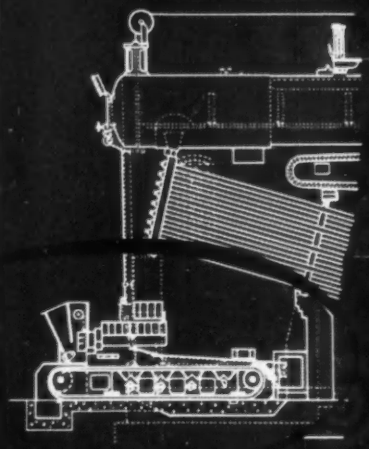
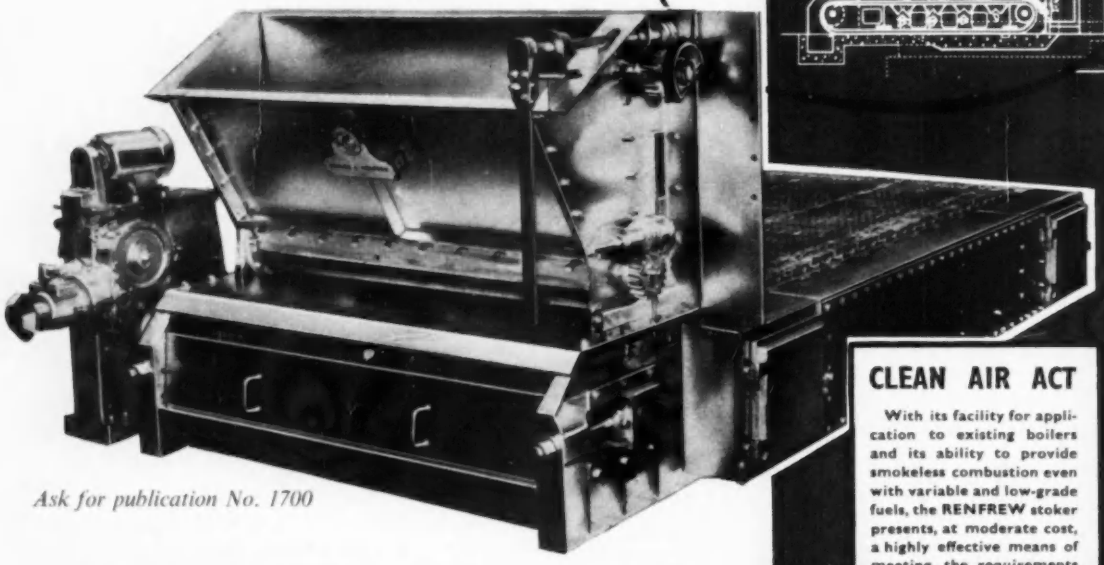




Illustrations: Above, Bi-drum boiler equipped with Renfrew stoker. Right, Renfrew stoker applied to existing, hand-fired water-tube boiler.



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Engineering and
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JANUARY 1959

VOLUME 74 No. 1

FUTURE POWER AND ITS COST

THE Electricity Council has just published a thirty-one page booklet, entitled *Power for the Future*, which gives a considerable amount of background information concerning the Electricity (Borrowing Powers) Bill, presented to Parliament on Tuesday, December 9th. This booklet includes a brief outline of the development of the electricity supply industry in England and Wales, gives an estimate of the further rise in demand over the next few years, and indicates the approximate cost of providing the means necessary to meet this demand up to the years 1964/65. Allowances are made for a continued increase in efficiency of generation and an improvement in load factor, and an estimate is also given of the proportion of capital requirements which will be met from what is referred to as internal sources.

Records show that since 1920, the earliest year for which reasonably complete figures exist, sales of electricity have expanded twentyfold, and the growth continues unabated. Between the two world wars, the number of consumers rose from less than one million to over nine million—eight million of them domestic. There is no sign of approaching saturation in the use of electricity in industry, commerce, the public services or in the domestic field. During the past twenty years, more than five million new consumers have been connected to the supply system. This figure is impressive, but the significant development of the post-war years has been the increase in average annual consumption which, for every class of user, has risen rapidly. Largely due to the many new applications of electricity, the 1957/58 electrical energy requirements of all classes of consumer in England and Wales were more than twice those of the previous decade. In industry, for example, efficiency of production is closely dependent upon the availability of increased horsepower per worker, and the latest estimates suggest that industrial sales of electricity are likely to increase by nearly two-thirds in the next seven years. A similar increase is forecast in the sale of electricity to domestic users. Sales to commercial consumers are expected to rise by 50 per cent., and sales to farms are likely to be doubled. The public services are comparatively small users of electricity, but thanks mainly to the railway electrification schemes included in the Modernisation Plan of the British Transport Commission, consumption is expected to increase by 50 per cent. in the next seven years. On present estimates, the electricity supply industry is, therefore, planning to satisfy a maximum demand of 29.5-MW in the winter of 1964-65 compared with a present maximum demand of 20.8-MW. To meet this obligation, the supply industry is programming for thirty-eight new power stations (including five nuclear stations and five new high-pressure installations), a considerable expansion of the grid and super-grid systems (including supplies likely to be made available by the Atomic Energy Authority), and (after 1961) by Electricité de France via the cross-channel cable.

The cost of all these projects during the next seven years is likely to reach the formidable total of £2,130 million. Of this total, £1,030 million is to be sought from internal resources, including trading surpluses and provision for depreciation. The balance, £1,100 million, is to be raised by borrowing, and the necessary legislation is being introduced in the Electricity (Borrowing Powers) Bill. The above figures indicate that over the seven-years period, the electricity supply industry, in replacing and modernising its assets and increasing its capacity to meet growing demand, expects to finance about 48 per cent. of its gross capital requirements from internal resources as compared with 42 per cent. in the period 1948-49 to 1951-58. This level of internal financing will represent some 20 per cent. of revenue from sales of electricity. To meet the special problems posed by this programme of expansion, the Generating Board has changed the organisation inherited from the Central Electricity Authority, with two main objects—first to achieve greater decentralisation in day-to-day management and operation and, secondly, in view of the changing pattern of the capital development programmes, to reduce the number of units concerned with power station construction.

Total capital absorbed during the twenty years to March 31st, 1958, amounted to £1,671 million, of which, £706 million, i.e. 42 per cent., was met from the industry's internal resources, and, of this, £100 million represented the aggregate surpluses for the period. In spite of rising prices, the average revenue per unit, sold in 1957/58, was, as a result of the economies achieved by increased efficiency, only 34 per cent. above the average for 1947-48. The motive behind the wide borrowing powers now under review, and the prodigious capital expenditures envisaged are, of course, to give this country the means to be strictly competitive as an industrial nation, so that it can earn for itself a higher standard of living.

Points and Pointers

MORE SCIENTISTS AND ENGINEERS The annual report for 1957-58 of the Advisory Council on Scientific Policy has recently been published. It covers the financing of scientific research in British universities, scientific manpower, scientific and technical literature and overseas scientific relations. The Council favours retention of the existing alternative sources of finance, which include the general purpose funds of the universities, the research councils and the Royal Society and other bodies such as Government departments, charitable foundations and industry. It appears that their reason for this recommendation is that if there were a single source of finance, newly emerging subjects and development of research under the stimulus of an exceptional man might fail to receive sufficient support. The report contains an encouraging review of the progress made with the task of increasing the supply of scientists and engineers. In 1957 the total number of scientists and engineers who qualified (either as university graduates or as members of professional institutions) is estimated at about 13,000 compared with 11,000 in 1955. If the expansion plans already drawn up for universities and technical colleges are fulfilled, they will together be providing some 22,500 scientists and engineers a year by 1970, which would exceed by a small margin the target set by the Committee on Scientific Manpower in 1956. The Council points out, however, that the main problem is likely to be the supply of teachers. Most secondary schools are already short of graduate teachers of science and mathematics, and the position seems likely to grow worse. Moreover, the Council does not consider that recent measures to improve the supply of teachers will meet the immediate need. It hopes that the task of teachers will be eased by the provision of more accommodation and the modernisation of laboratories and equipment as rapidly as schemes can be approved.

DISPERSAL OF POWER STATION EMISSIONS Full confirmation of the efficacy of the tall chimney, emitting high-velocity, high-temperature gases, in attaining gas dispersal, even under severe fog conditions, has now been obtained. Both visual and photographic surveys of the top of a recent fog blanket which formed over the London area have shown that power station chimneys are capable of producing a thermal draught sufficiently strong to penetrate fog layers at least 750 ft. high above ground-level, and that, above the top of the fog, the gases disperse into the upper atmosphere in the normal manner. In order to carry out the investigation, the Central Electricity Generating Board chartered an aircraft from Fairey Air Surveys Ltd. Special navigational equipment was installed to permit safe flying in the necessarily poor conditions and to allow the individual power stations to be picked out. This task was eased by the provision of local ground/air communication, and in one case, that of Brunswick Wharf power station, by the emission over a specified period of time, of red and black smoke from the chimney stacks. It is claimed that the results have shown that no contribution to ground fog conditions is made by tall chimneys emitting hot, high-velocity gases; but it was noticed that the chimney plume from Bankside power station was ineffective in penetrating the fog layer. This results from the use of the gas-washing plant, which is instrumental in providing a relatively cool emission. The Research Department of Fairey Air Surveys provided great assistance in devising the necessary photographic and survey techniques, and full co-operation was extended in the exercise by the London Airport traffic and navigational control authorities and the Meteorological section.

INSULATION CONFERENCES Considerable interest is already being shown in the Heat and Sound Insulation Exhibition, and the associated conferences on thermal insulation and noise in industry, which are to be held at Earls Court, London, in conjunction with the Factory Equipment Exhibition in April next. It is announced that the conference on noise in industry is to be opened by the Rt. Hon. Hilary Marquand, M.P., who has for many years exhibited a keen interest in this problem. Mr. Marquand is a former Paymaster-General, Minister of Pensions, and Minister of Health. Many organisations are represented on the conference advisory committee, including The British Productivity Council, British Standards Institution, Building Research Station, Federation of British Industries, Institution of Mechanical Engineers, Institution of Production Engineers, Ministry of Supply, National Physical Laboratory, Structural Insulation Association, and others. The thermal insulation conference is to be opened by Sir Leslie Hollinghurst, G.B.E., K.C.B., D.F.C., Chairman of the National Industrial Fuel Efficiency Service. Speakers for both conferences will be announced later. The conferences and exhibition will provide an outstanding forum for the latest developments, opinions and ideas. Leading firms will be showing a wide range of modern insulating materials, constructions and application methods, including Cape Asbestos Co. Ltd., Darlington Group (including Chemical & Insulating Co. Ltd. and Darlington Insulation Co. Ltd.), Fibreglass Ltd., Wm. Kenyon & Sons (Meta Mica) Ltd., Newalls Insulation Co. Ltd., Asbestos Cement Co. Ltd., and numerous others.

BRITAIN'S LARGEST TURBO-GENERATOR The Central Electricity Generating Board has placed a contract for the largest turbo-generator unit yet projected in Britain. The unit, which is to be built by C. A. Parsons & Co. Ltd., will have a capacity of 550-MW. It will be installed at the Thorpe Marsh power station, near Doncaster, and is scheduled for commissioning in 1963. The value of the contract, which includes condensing and feed-heating plant, and main boiler feed pumps, is well over £4 million. The turbo-generator will be a two-shaft machine operating

two alternators, each of 275-MW. Steam will be fed into the machine at a pressure of 2,300 lb./sq. in. and a temperature of 1,050-deg. F. The machine is to be a cross-compound unit, consisting of two lines arranged in line ahead, each line comprising four cylinders driving a 275-MW hydrogen- and liquid-cooled alternator. All eight cylinders will be of the double-flow type. Steam will enter the high-pressure cylinder on one line and be exhausted from it to the reheat section of the boiler where it will regain its initial temperature of 1,050 deg. F. The reheated steam will then be passed to the first intermediate-pressure cylinder heading the other line, and on leaving this turbine will divide equally between duplicate intermediate-pressure cylinders, one on each line. Final expansion of the steam will then be effected through the two low-pressure cylinders on each line. The steam issuing from the eight exhausts will enter four condensers with a total cooling surface of 330,000 sq. ft. Voltage of generation is to be 18-kV at 3,000 r.p.m. The alternators will have direct-gas-cooled rotors operating with a hydrogen pressure of 45 lb./sq. in. and the stators are to be cooled with demineralised water which will circulate through the conductors.

ELECTRICITY SUPPLY SCHOLARSHIPS

Particulars of university scholarships for sixth-form students, enabling them to read for engineering or science degrees, were recently announced by the Electricity Council. As many as sixty can be awarded annually by the Central Electricity Generating Board (25) and the Area Electricity Boards (up to three each). When the scholarships were mentioned at a meeting of the National Joint Advisory Council, they were welcomed by the Electrical Power Engineers' Association and the other trade unions concerned, but with the qualification that present employees should be given equal consideration for such educational opportunities. There are already scholarships schemes for those within the industry but an assurance was given that these would be modified and improved so as to ensure that anyone on the staff, with the necessary preliminary requirements, would not be held back. This is as it should be, for although the candidates from outside may elect to stay in the industry after the two years specified in the terms of the scheme, it is more likely that those already employed in electricity supply will remain in it and raise the general standard.

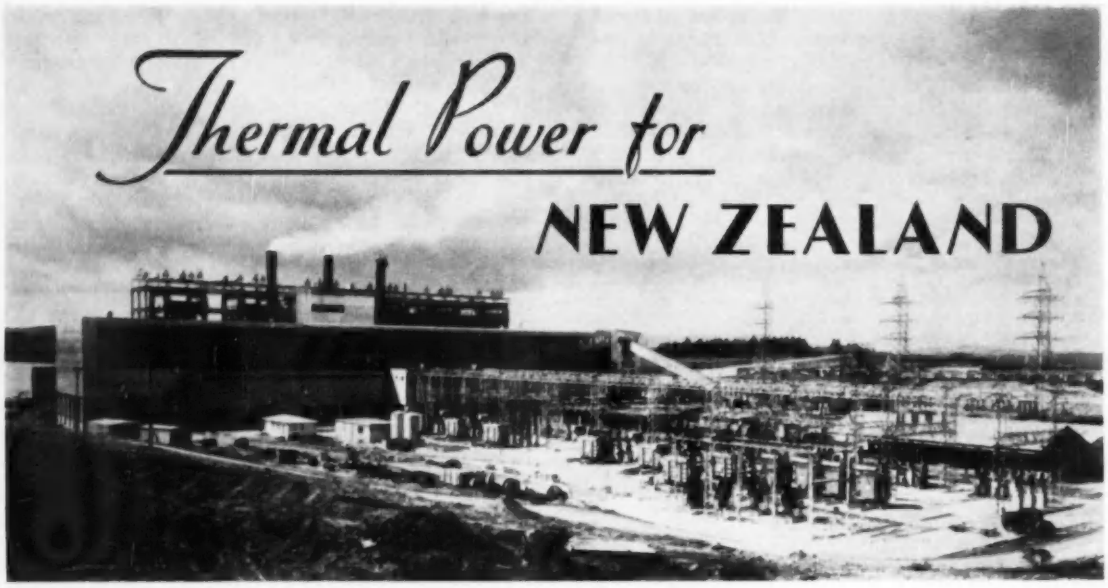
CALDER HALL

The United Kingdom Atomic Energy Authority recently announced that all the reactors at the two Calder Hall nuclear power stations are now working. This stage was reached during the night December 8th/9th, when the fourth reactor on the site went critical, i.e., when the amount of uranium inserted into the core became sufficient to cause a self-sustaining reaction. The operation was successful and this reactor (or pile) will now undergo a series of tests while working up to full power in preparation for linking with the grid system to provide electricity. There are, of course, two atomic stations at Calder Hall, known as "A" and "B." Work on the first of these started in the summer of 1953 and on the second in 1955. Each station has two reactors and the first of the two in Calder "A" started operating in May, 1956. It will be remembered that it achieved full power and was switched into the grid on October 17th, 1956, by Her Majesty the Queen. It thus became the first atomic power station in the world to produce electricity on a commercial scale. Both the reactors on the first station have been supplying electricity to the national grid system successfully since February, 1957. The power capacity of the four turbo-alternators associated wtih the two reactors is 92-MW, of which about 70-MW is used by the grid. So far, just over 750 million kWh have been supplied. The first reactor of Calder Hall "B" started operating in March, 1958, and has been running successfully. Delivery of power was delayed by an accident to a turbo-alternator in June, but will probably take place almost immediately. The reactor which started operating a few weeks ago will be associated with electricity production in about two or three months' time. The two stations together, will have a capacity of 184-MW and will supply 140 MW to the national grid. A similar station at Chapelcross, near Annan, in Dumfriesshire, with four reactors, is now nearing completion. One of the reactors is already operating, and the whole station will be completed in 1960.

THE WORK OF THE BOILER AVAILABILITY COMMITTEE

The work of the Boiler Availability Committee was the title of a short symposium presented at a meeting of The Institute of Fuel, held in London on Wednesday, December 17th, at which six papers were presented. The authors of the papers are members of the Technical Committee of the Boiler Availability Committee. Mr. F. W. Lawton, chairman of the Boiler Availability Committee gave a general introduction in which he explained that the committee was formed in 1941 with the object of conducting investigations to enable the overloaded power station boilers in this country to cope in some manner with the enormous increase in demand occasioned by World War II, in spite of changes in fuel supplies brought about by war-time conditions. The sponsors of the committee are the Central Electricity Generating Board, the South of Scotland Electricity Board, and the Water-Tube Boilermakers Association. In addition, active, and valuable support is given by other boiler and equipment manufacturers. The first technical paper was presented by Dr. H. E. Crossley and it was intended to be a critical appraisal of the work of the Boiler Availability Committee. The second technical paper was by Mr. D. C. Gunn, who dealt with the occurrence of corrosive substances in boiler flue gases, the use of additives in the flue gas system as a means of either neutralising or absorbing the acid produced, and methods of estimating the amount of corrosive substances present. Mr. W. F. Harlow dealt with numerous problems concerning boiler plant deposit formation and corrosion, the important factor of which he claimed was the formation of sulphuric acid in the flue gases. A contribution by Mr. J. R. Jenkinson also dealt with various corrosion problems and methods of overcoming them. He also made reference to the highest temperature at which sulphuric acid first condenses on a metal surface, and said that the amount which settles is not dependent on a simple condensation process. If it were so, any metal at a temperature below the acid dewpoint would receive liquid acid from the gas and as the temperature differences between gas and metal increased, the amount of condensation would increase.

Thermal Power for NEW ZEALAND



THE 180-MW Mercer steam power station in New Zealand, now nearing completion on the right bank of the Waikato River some 45 miles south of Auckland, is the only major coal or oil-fired station in New Zealand, where the hydro-electric potential in both North and South Islands has been extensively developed over many years. When the need for a North Island coal-fired steam station, to operate at a high load factor to conserve water resources, was established in 1952, the London firm of consulting engineers, Messrs. Preece, Cardew and Rider, was appointed to investigate and report on the project. The approximate present site, and generally the capacity and main design features of the present station were recommended at that time; but for financial and other reasons the project was not revived until 1955. In September, 1955, the consulting engineers were instructed by the N.Z. Government to make final recommendations on the optimum site for the new station and to proceed with the designs, specifications and contracts, on an extremely urgent basis, on behalf of the Ministry of Works, and with the collaboration of the eventual operating authority, the State Hydro-electric Department which now is renamed the New Zealand Electricity Department. The civil engineering consultants associated with Messrs. Preece, Cardew and Rider in the project, are the London firm of Sir Alexander Gibb & Partners.

It was laid down by the N.Z. Government that the whole of the construction work on the site, including the erection of the plant, should be carried out under a single site contract, and that at least one member of the contracting group or consortium should be an approved New Zealand firm of contractors. Following fully competitive tendering, which was not confined to British firms, the separate F.O.B. contracts for the supply of all principal plant and equipment were placed in record time, and, as a result of prior clearing and levelling operations undertaken on the site by the Ministry of Works, the site contractor (Morrison-Downer-Ferguson) who was appointed in April, 1956, was enabled to commence construction work almost immediately. In spite of severe initial handicaps due to abnormal weather conditions, and subsequent site difficulties of various kinds, the first two 30-MW machines of the six-unit station were commissioned in August, 1958, and it is anticipated that virtually the complete station will be in commercial operation about the middle of this year. The construction and equipment in a distant country of the six-unit station as a single project, under the urgent requirement of part commissioning within less than three years from the date of initial authorisation, has been a formidable task, and these conditions, among others, have had a material effect on the design and layout of the station, the choice of number and capacities of the generating sets, and the steam conditions adopted.

Illustration at top of page is a recent view of Mercer Power Station from the South-West, showing present state of constructional progress.

The site is adjacent to the main Auckland highway skirting the Waikato River bank, within easy reach of the N.Z. Government Railways' trunk route, and the high-voltage transmission system. It is situated about six miles from the principal source of opencast coal, with which it is connected by aerial ropeway over difficult swamp land. The site was selected with due regard to its suitability for the permanent housing of the operating staff in the near neighbourhood.

The equipment of the station site is of a fully comprehensive character, in that it includes means for the automatic handling of supplementary road and rail borne coal received from a distant source, in addition to the opencast coal delivered by aerial ropeway; also the automatic transport and disposal of boiler ash over the neighbouring swamp land, special provisions for the utilisation of low and medium grade coals of widely varying ash and moisture content, and facilities for the future installation of electrostatic dust precipitator plant at minimum cost

should conditions arise that warrant it. The site equipment also includes a complete outdoor high-voltage transformer and switchgear compound.

The station is of the semi-outdoor type to the extent that the entire boiler and draught plant is in the open, with only protective wall sheeting on the turbine room side, and roof sheeting over the vulnerable boiler tops. In other respects the station is of the conventional indoor type, except that the whole of the structural design of the station, and to some extent of the plant, is characterised by the provision of special measures against the possible effects of seismic disturbance and earth tremors.

The plant in the completed station will comprise six 30-MW generating units, designed for stop-valve steam conditions at 600 lb./sq. in. and 850 deg. F., with a similar number of 300,000 lb./hr. boilers. These sizes and steam conditions were decided upon after full consideration of all such circumstances as speed of manufacture and erection, the difficulty of obtaining suitably experienced staff and the limitations of available transport. The boilers are arranged for pulverised-fuel-firing, with oil lighting-up equipment. Provision has also been made for the possible addition of partial coke-oven gas firing at a later date for operation in conjunction with a projected creosote plant. Since the coal used has an inherent moisture content of nearly 25 per cent., abnormal provision had to be made for the supply of high temperature air to the mills. Consequently, each boiler is provided with an additional "topping" air-heater to enable primary-air temperatures up to 700 deg. F. to be achieved when necessary.

The arrangement of the boiler plant is unusual in that the coal-bunker structure and pulverising plant is situated in between the boilers and the air-heater and draught plant. The pulverised-fuel burners are situated at the top of each boiler furnace and at the back, and the above-mentioned arrangement of the milling plant considerably reduces the length of the coal pipes. Advantage has also been taken of this arrangement to reduce the height of the bunkers by at least 25-ft. from the more conventional and higher position which they would be required to occupy in the front of the boilers, to provide access in the firing-aisle for pipework and personnel. This results in an important saving in structural steelwork, which is the more appreciable by reason of the requirement to provide for the effects of possible seismic disturbance.

Fig. 1 (top). View of station site (lower right hand corner) during clearing and levelling operations.

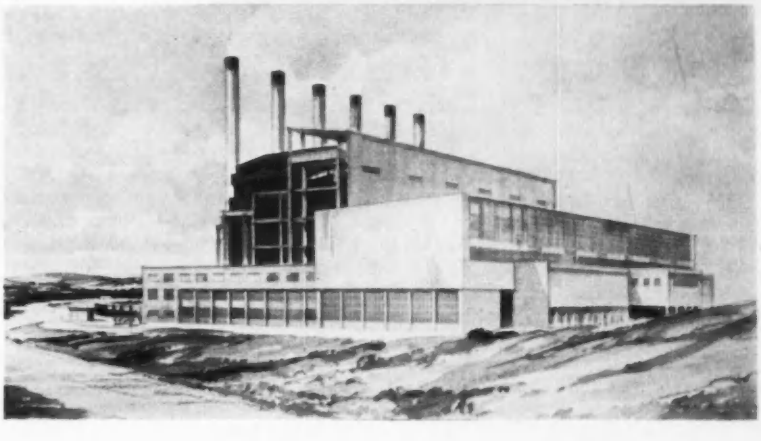


Fig. 2 (centre). Aerial view from North-West showing structural steelwork erection progress.

Fig. 3 (right). Artist's impression of the appearance of the completed station.

Coal-handling plant

Supplies of coal from an open-cast mine at Maramarua approximately 6½ miles from the station are transported by twin aerial ropeways supplied by Ropeways Ltd., and capable of handling 2,000 tons in a normal working day. This aerial ropeway forms an integral part of the power station project and will be operated by the station staff. In addition, facilities are provided for receiving coal from another source by road or rail, as necessary. A railway marshalling yard connected to the main line is provided, capable of accommodating coal train loads of 400/450 tons each. The complete coal handling plant on the site was supplied by Babcock & Wilcox Ltd. Rail-borne coal is discharged by means of automatic wagon tippler equipment which is capable of dealing with 1,000 tons per day. The coal is then handled by a system of belt conveyors and a travelling tripper delivers it at a maximum rate of 400 tons/hr. into the boiler house bunkers. The road borne coal is discharged into a ground hopper adjacent to the wagon tippler, and is then delivered by the same system of conveyors at a rate of 400 tons/hr. to the boiler bunkers, or to the 40,000 tons capacity storage area, which is also served by a drag scraper equipment for stocking-out and for reclaiming purposes.

Coal is fed from the mine at Maramarua by means of a belt conveyor at a maximum rate of 300 tons/hr. on to the twin ropeway system which conveys it to the power station and delivers it into an unloading bunker. Thence it is fed by a further belt conveyor on to the system referred to above, by which it is ultimately delivered to the boiler bunkers or to the storage area. The combined operation of the various conveying systems enables a maximum overall discharge rate into the boiler bunkers to be maintained at 600 tons/hr. The coal-handling equipment provides crushing and screening facilities for the large coal obtained from the opencast mine, though it is expected that the rail borne deliveries will be normally of screened coal. Belt weighing equipment is also provided. The coal is liable to spontaneous combustion if stored dry after mining, and arrangements have therefore been made to enable the storage area to be kept flooded with water, although this can be drained when reclaiming the coal.

Eight of the Babcock conveyors are driven by motors ranging from 15-85 h.p., and running at 960 r.p.m. through fluid couplings of the traction type, in sizes from 14.5 to 23-h.p., supplied by Fluidrive Engineering Co. Ltd., who also supplied a size-23 traction coupling rated for 40-h.p. and 720 r.p.m. for the motor driving the wagon tippler, and two size-26, type SCR4 fluid couplings for use in conjunction with the 185-h.p., 987 r.p.m. squirrel-cage motors driving the aerial ropeway.

Boiler plant

The six 300,000 lb./hr. boilers are of the High Head Radiant type and are being supplied by Babcock & Wilcox Ltd. Each unit has a fully water-cooled furnace of 33,600 cu. ft., the walls being of bare-tube construction. The furnace is fired by six B. & W. multi-tip p.f. burners, six oil-burners also being fitted for lighting-up and for steaming at light loads, up to 10 per cent. of full load. Three Babcock & Wilcox type E.56 pulverising-mills, and three primary-air fans each designed for a capacity of 20,000 cu. ft./min. at 700 deg. F., at full mill output and when wet Maramarua opencast coal is being used, are supplied per boiler, but any two of the mills and fans are normally adequate for steaming the boiler at full load. The heating surface of the boiler proper is 2,040 sq. ft. (Radiant), and of the primary and secondary superheaters 8,070 and 2,660 sq. ft. respectively. Two forced-draught and two induced-draught fans serve each boiler—the capacity of each F.D. unit being 51,000 cu. ft./min. at 90 deg. F., and that of each I.D. unit 85,000 cu. ft./min. at 320 deg. F.

All the mechanical draught fans, comprising twelve I.D., twelve F.D., and eighteen primary-air fans, were supplied by Johnson Bramley & Co. Ltd., now the wholly-owned subsidiary of E. Green & Son Ltd., at whose Economiser works at Wakefield the fans were constructed and tested. Although the name "Green" is a new one in the field of power station fan equipment in this country, the suppliers guaranteed efficiencies of a very high order for these fans. Performance figures on tests substantially exceeded those originally specified; total efficiencies in excess of 90 per cent. having, in fact, been obtained. Since obtaining this contract, the suppliers have similarly equipped power stations and industrial undertakings both in this country and abroad, working in conjunction with the Green Fuel Economiser Co. Inc., who currently manufacture some of the largest fans on the American Continent.

An economiser of the Babcock & Wilcox continuous loop type, arranged in two banks, is installed in the open pass above the superheater in each boiler. The heating surfaces of the top and bottom banks are 6,550 sq. ft. and 5,620 sq. ft. respectively; thus giving a total economiser heating surface per boiler of 12,170 sq. ft. The main air-heater for each boiler is of the Babcock & Wilcox horizontal tubular type, with three air passes, and one gas pass, in counterflow.

Boiler control equipment

Each boiler is provided with individual combustion control equipment, together with superheat temperature control by means of a Babcock & Wilcox spray-type attemperator arranged interstage between the superheater primary and secondary sections. For all six boilers the panels, instruments and automatic control equipment were supplied by George Kent Limited, Luton. The control system comprises master control of steam pressure by positioning the primary-air dampers at each mill inlet, steam/air ratio control which operates on the forced-draught fan and balanced-draught control in the combustion chamber, maintained by sensitive furnace pressure regulators operating on the induced-draught fans. Mill temperature controllers regulate the proportion of cold to warm air entering each mill, and steam temperature control employs the cascade system in which a temperature controller at the secondary superheater outlet adjusts the desired value setting of another temperature controller working from a thermocouple at the secondary superheater inlet, according to the final steam temperature. The control signal is transmitted to a diaphragm-operated valve which regulates the flow of spray water to the attemperator. A master panel, common to the six boilers carries the three Kent master steam-pressure controllers with their associated auto/manual control stations. Normally, each controller maintains steam pressure in two boilers but can, by means of changeover

valves, control the pressure in all six boilers. The remaining controllers are mounted on the appropriate boiler control panel of which there are six (one for each boiler). These panels, in addition to the Kent pneumatic control instruments enumerated, carry the operating instruments (comprising flow-meters, draught gauges, oxygen meters and temperature indicators/recorders, etc.) also the hydraulic remote damper controls and the electrical controls for the fans and milling plant. The automatic control scheme will utilise a total of sixty Kent power cylinders to position the mill dampers and fan vanes.

Automatic steam-operated soot-blowing equipment supplied by Jones Tate Ltd., is fitted to each boiler and economiser, while shot-cleaning equipment is provided for the air-heaters.

Boiler valves and mountings were supplied by Dewrance & Co. Ltd., and comprise boiler and superheater safety valves, Maxiflow-type drum safety-valves, external high and low-water whistle alarms, fabricated steel water-gauges, with and without Dewrance patent bi-colour illuminated water-level indicator; consolidated electromatic relief valves, forged-steel drain valves and sootblower master valves, complete with Jones-Tate electric actuators. Also included are Dewrance parallel-slide valves for the main steam pipe lines, including Dewrance non-return isolating valves.

Various pipe-line valves and turbine valves were supplied by Hopkinsons Ltd. They included a large number of parallel-slide valves and Hopkinson-Ferranti valves, electric valve controls, " Uniflow " valves, combined stop and non-return valves, automatic shut-off valves and spring-loaded bypass valves.

Steam from the superheater outlets is led to a sing' bus-main which can, if required, be divided into three equal sections. An auxiliary steam main is also provided to supply the station ancillary plant at all times independently of the bus-main. Steam to the turbines is fed through unit steam separators connected to the bus main, and each turbine supply pipe is provided with a tapping for turbine auxiliaries.

The boiler and turbine insulation work was carried out by Newalls Insulation Co. Ltd.

Damper control equipment

Lockheed hydraulic controls, supplied by Automotive Products Co. Ltd., are used for controlling the eighteen dampers on each of the six boilers, and the equipment provides for the automatic closing of six of these in the event of fan-motor stoppage. The Lockheed controls are power-hydraulic, but manual-hydraulic operation is incorporated at each control station, as an instantly-available stand-by

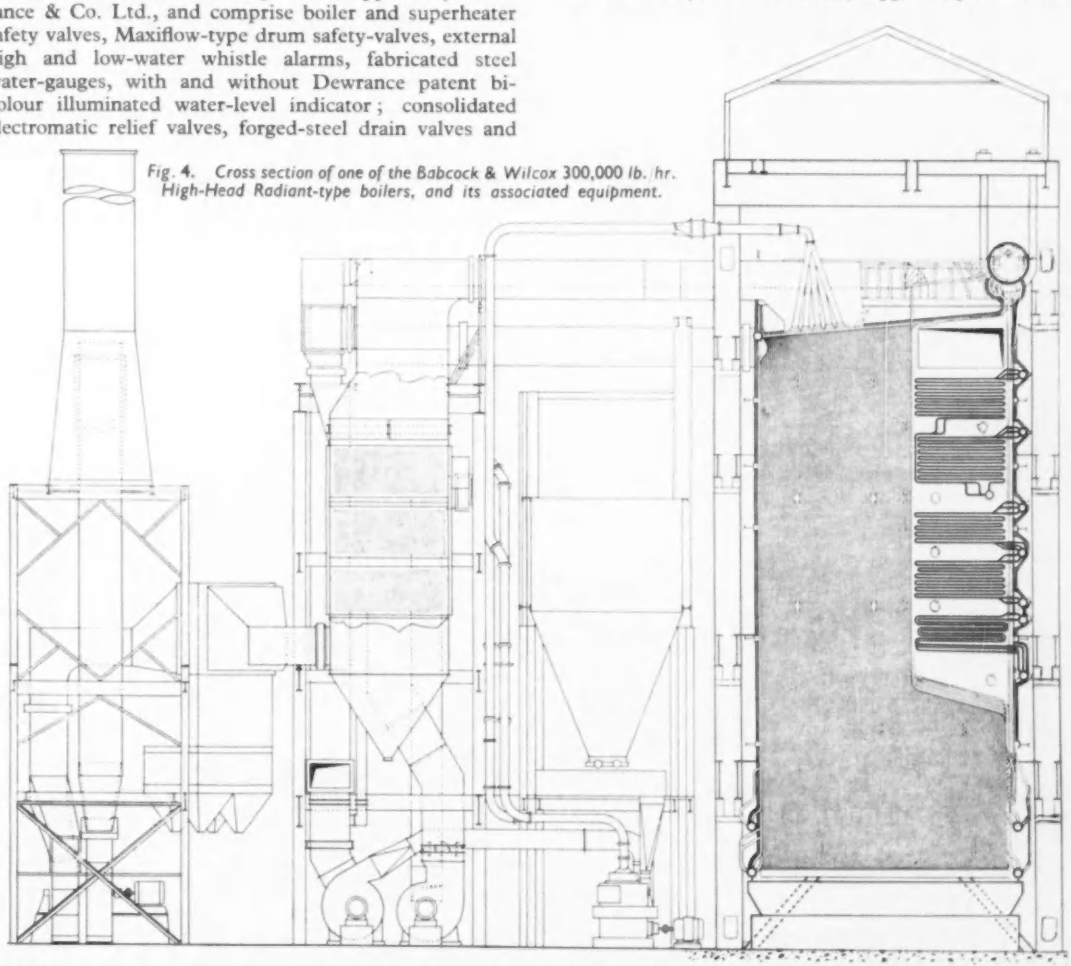


Fig. 4. Cross section of one of the Babcock & Wilcox 300,000 lb. hr. High-Head Radiant-type boilers, and its associated equipment.

for use in the event of power failure. For each boiler, the eighteen hydraulic cylinders are brought into circuit, one at a time, for operation as desired, through the medium of selector valves, of which there are three six-way groups per boiler. Direction and speed of movement of the selected damper is controlled in the usual way, by the direction and degree of movement imparted to the control handle of a metering and reversing valve. Six 1¼-in. "High Duty" Autoloc cylinders of 6-in. stroke are employed for dampers controlling the hot air supply to burners, while two cylinders of the same type and stroke are used for the F.D. fan to air-heater dampers. For the air-heater air outlets two Autoloc cylinders are used, and a further pair of cylinders are employed to control the I.D. fan discharge. These latter, however, are of the non-locking type, and are used in conjunction with hydroloc valves, so that hydraulic locking is provided in this case instead of the mechanical locking of the Autoloc type piston. Two Autoloc cylinders are used for the air-heater bypass dampers, and a further pair of cylinders control hot air recirculation. Two further Autoloc cylinders are used for the dampers regulating the flow of hot gas from the superheater zone to the topping air-heater. Electrical isolating or "limit" indication, by means of red and green signal lights, arranged in "pair" units of edgewise form on the control panel, is employed for the I.D., F.D. and air-heater outlet dampers, while regulating indication by means of two edgewise-type indicators is provided for the remaining twelve points. Thus, the Lockheed equipment provides for the automatic closing of six of the eighteen dampers served on each boiler; the six being the two I.D. and two F.D. fan dampers, together with the two dampers for the air-heater air outlets each of which latter closes automatically with its associated F.D. damper. The Mercer damper control installation is another example of the useful versatility of the auto change-over valve—a small, simple unit which is unique to hydraulics. Auto change-over valves are used, in this case, to allow fluid pressure to reach the appropriate ends of operating cylinders either from the panel-mounted selector valves, to bring about the closing of dampers in the normal way, or from the thrustor-operated control valves for the automatic closing of the same dampers. This installation is also an example of the use of hydraulics to provide safety locking of automatic controls which are dependent on air pressure for their normal operation. In the event of failure of air pressure, all pneumatically-operated "automatic" controls are instantly locked at the stroke-positions occupied at the moment of air-pressure failure. This, of course, eliminates the possibility of any "drift" or "hunting" in these controls, and the undesirable and even unsafe conditions that might result. The equipment for hydraulic locking has been supplied to the order of George Kent Limited.

Ash-handling plant

Flue dust is collected in a multi-cyclone type separator supplied by Davidson & Co. Ltd., and removed to the ash-disposal system by a high-pressure water-jet-operated plant supplied by Babcock & Wilcox Ltd. Ash-hoppers with quenchers are arranged under each boiler to collect the ash, which is discharged at intervals into a sluiceway along which it is conveyed to a transfer sump, and then pumped to the low-lying disposal area. Dust from the collectors is extracted by feeder ejectors and discharged as a slurry along pipeline and gravity sluiceway, also to the transfer sump and pumped to the disposal area.

Turbo-alternator plant

Three of the 30-MW turbo-alternators are being supplied by Metropolitan-Vickers Electrical Export Co. Ltd., and three by the English Electric Co. Ltd.

The turbines are of the two-cylinder type, and are provided with twin condensers designed to produce a normal vacuum of 29-in. Hg., with cooling-water at 70 deg. F. at the most economical rating. Circulating-water from the river is channelled in closed concrete gravity culverts passing under the main highway and

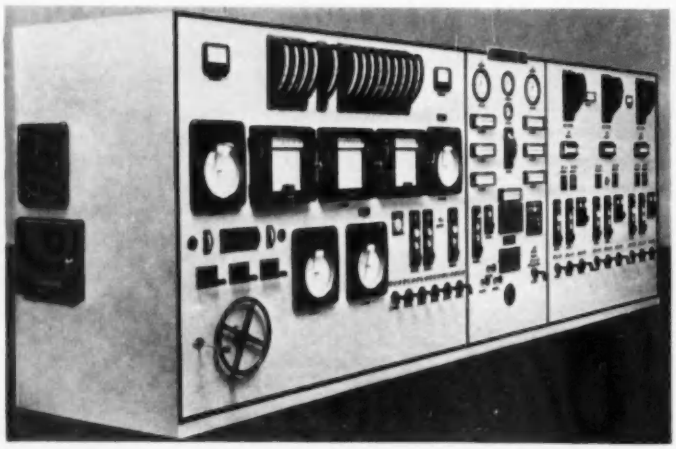


Fig. 5 (above). Boiler instrument and control panel for No. 4 unit.

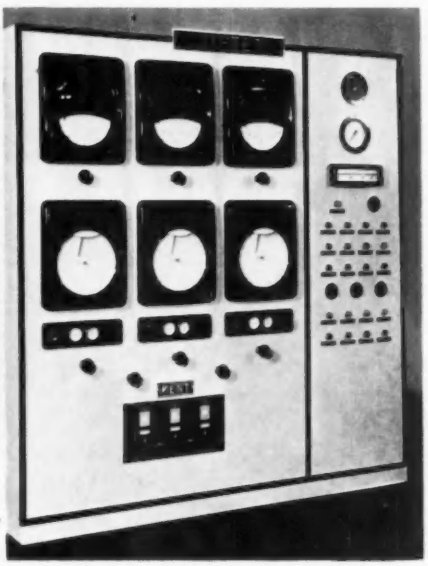


Fig. 6 (right). Master Control panel, which, like the individual control panels for each boiler, were supplied by George Kent Ltd.

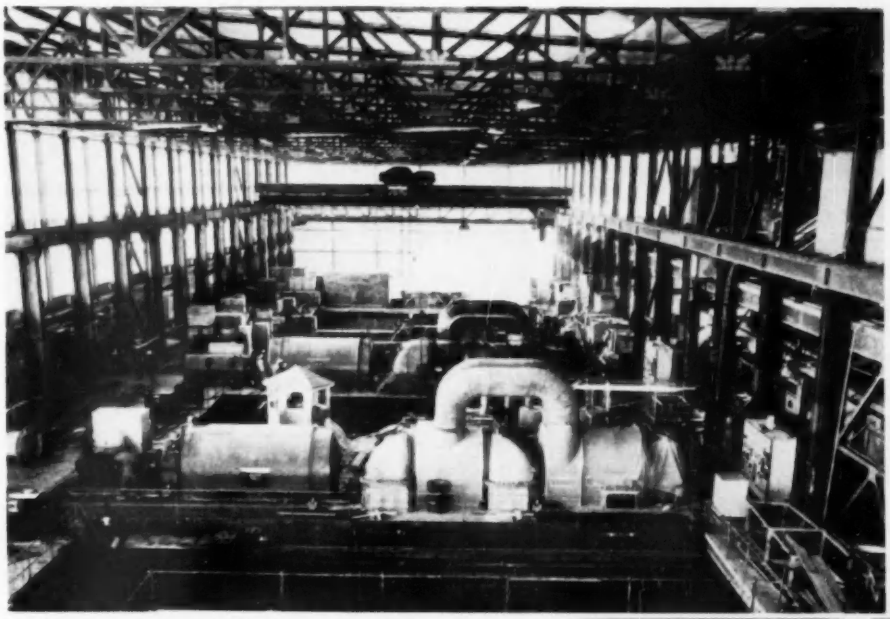


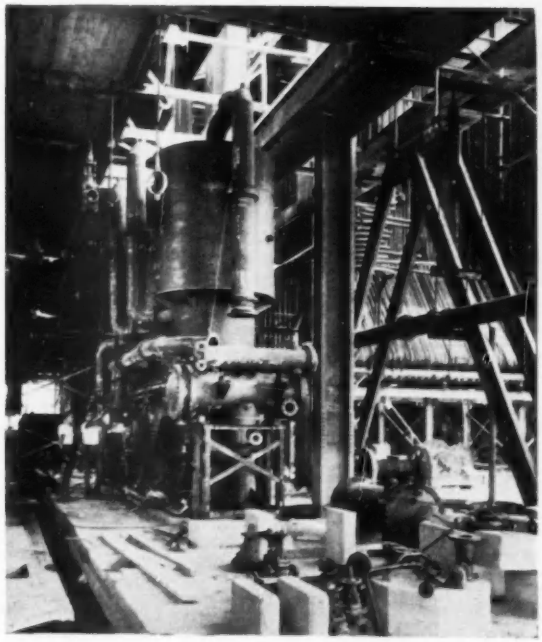
Fig. 7. The turbine house will ultimately contain six 30-MW turbo-alternators. Three are being supplied by Metropolitan-Vickers Electrical Export Co. Ltd., and three by the English Electric Co. Ltd.

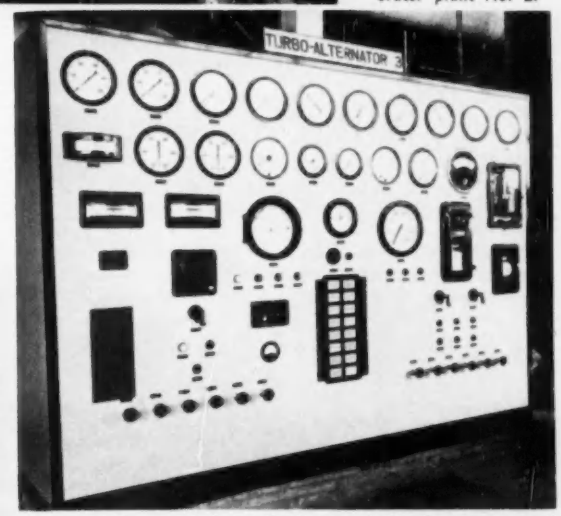
Fig. 8 (below). One of the turbo-alternator control panels.

Fig. 9 (below, left). View during erection of the Hick Hargreaves evaporator plant No. 2.

leading to suction and discharge chambers constructed beneath the station basement floor-level. From the suction chambers the water is circulated through each condenser by two vertical-spindle axial-flow pumps supplied by W. H. Allen Sons & Co. Ltd.

The twelve pumps are each fitted with bellmouth suction and 24-in. delivery bend, and designed to deliver 12,000 gall./min. of water against a total head of 20-ft. when running at a speed of 970 r.p.m. The pumps are each driven by a 140-h.p. vertical-spindle, totally-





enclosed, fan-cooled, squirrel-cage induction motor of Metropolitan-Vickers manufacture.

Band screening is provided at the river intake, the screening plant being supplied by Ledward & Beckett Ltd. The equipment comprises four double-flow screens designed to pass 3 million gall./hr. of water each, at minimum immersion of 11 ft. 6 in. The mesh panels are of stainless-steel, and fitted with silt buckets, the buckets on alternate panels being fitted with teeth for collecting weed and other debris. The screens are driven at a speed of 6 ft. or 12 ft. per minute, by 4/2 h.p. motors. Screen-washing water is provided by two Gwynnes 3-in. K-type split-casing centrifugal pumps supplying 200 gall./min. Each pump is connected through a Royles 4-in. twin strainer. Four stages of bled-steam feed-heating are provided, three of

which are on the high-pressure side of the boiler feed pumps. The final feed water design temperature is 345 deg. F. at maximum continuous rating.

The alternators are designed for a maximum continuous rating of 30-MW (most economical rating 24-MW), at 0.85 power factor and 11 kV nominal voltage. Each alternator is coupled to its own main and auxiliary exciter set.

Feedwater treatment plant

There are seven 325,000 lb./hr. electrically-driven boiler feed pumps which were supplied by Mather & Platt Ltd. These pumps are driven by motors supplied by the English Electric Co. Ltd. In addition, there is a standby pump. The latter is a 3-stage turbo-driven pump supplied by G. & J. Weir Ltd., and designed for an output of 325,000 lb./hr. a suction temperature of 165 deg. F.; suction pressure atmospheric + 40 ft., with a discharge pressure at the non-return valve outlet of 875 lb./sq. in. Speed is 5,000 r.p.m.

The two triple-effect re-compression evaporators were supplied by Hick, Hargreaves & Co. Ltd. Each unit is rated at 25,000 lb./hr. output. Both the evaporators have been built to a new compact design arranged for direct floor-mounting without the use of additional structural steelwork, with the centrifugal type separators being incorporated as an integral part of the body of each evaporator effect. As will be seen from the illustration, (Fig. 10) of one of these installations, taken at the maker's works at Bolton before despatch to New Zealand, all operating controls are accessible from one side of the plant only, at floor level. To enable the high performance of the evaporators to be maintained under partial load operation, two graded thermo-compressors are fitted on each plant, capable of giving alternatively 40 per cent., 60 per cent. and 100 per cent. output as required, when using live steam taken direct from the boilers, at 600 lb./sq. in., 850 deg. F. This arrangement allows the rate of make-up to be adjusted to suit the specific

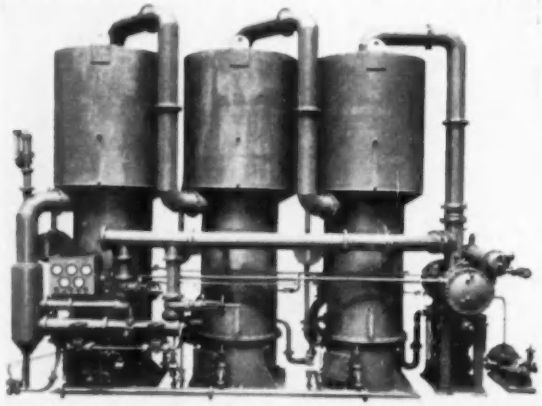


Fig. 10. The new type central evaporators which are of 25,000 lb./hr. output, and are being supplied by Hick, Hargreaves & Co. Ltd.

station requirements. The evaporators are also fitted with raw-water preheaters and vent condensers, the latter being required for use only during the starting-up period, as the design of the system is such that no surplus vapour is produced.

Two standard 60,000 lb./hr. Hick, Hargreaves shunt deaerators, with 6,000 gall. capacity deaerated-water storage tanks, are interposed in the two surge-tank balance legs between the tanks and the common boiler feed pump suction served by the six turbo-alternators. This make-up water supply is fully deaerated to a figure of 0.01 ml./litre before entering the boiler feed pumps and high-pressure feed-heating system. The deaerators are

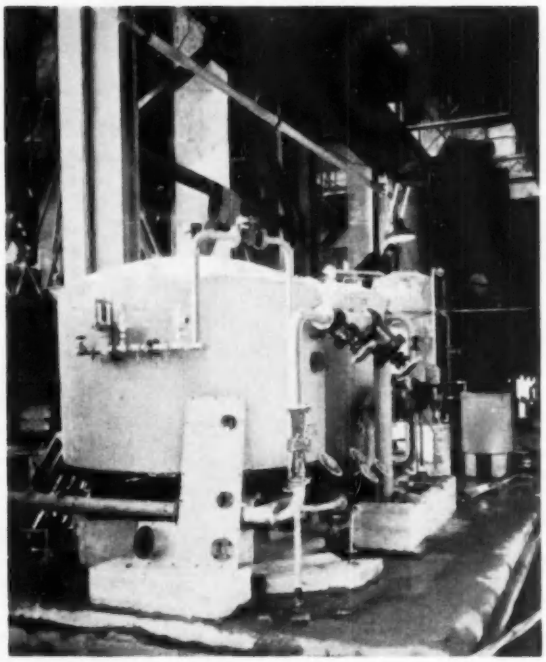


Fig. 11. View during erection of part of the water treatment plant which is being supplied by The Permutit Co. Ltd.

so designed that they may be operated whilst the main plant is shut down so that make-up water can be admitted to the system in a fully deaerated state for the purpose of topping up the boilers whilst the turbines are off-load.

The boiler feedwater treatment plant was supplied by The Permutit Co. Ltd., and consists of two identical sections, each with a coagulation and filtration unit; a fully-automatic Ion-exchange softener; and a mixed-bed "Deminrolit" unit. The coagulation and filtration unit in each case consists of alum and soda dosers, a booster pump, and a 7-ft. 6-in. diam. pressure sand filter. The raw water is pumped at a rate of up to 4,000 gall./hr. through the pressure filter, but before passing into the unit it is dosed with alum to coagulate the suspended impurities. A small dose of soda-ash is also added to adjust the pH of the alum-treated water to obtain the optimum coagulation. The coagulated suspended matter is removed on passage through the filter, and the clarified water flows to the ion-exchange softener where hardness-forming calcium ions are replaced with non-hardness-forming sodium ions. Each softener is regenerated automatically, the process being initiated by the Permutit automatic hardness tester, after approximately 145,000 gall. of water have been treated. Finally, the softened water is passed to the evaporators and then to the mixed-bed Deminrolit unit where residual dissolved solids are

removed. This unit is designed to treat 420,000 gall. in this way before regeneration is necessary.

Electrical plant

The 11-kV alternators are connected solidly to 110-kV step-up transformers and to 3.3-kV unit transformers. With the exception of the boiler feed and ashing pump motors, all unit and station auxiliary motors are supplied at 400 V. In addition to the various unit and unit auxiliary switchboards, a main 3.3-kV station board is provided, which derives its supply from the 33-kV outdoor substation and can be interconnected with the unit boards for starting-up purposes or as standby. Two outside substations provide supplies for the coal-handling plant. Supplies for lighting and space heating, etc., are taken from the station auxiliary boards, no special lighting transformers being provided. Automatic changeover to d.c. from the station battery is provided for selected lighting and instrument circuits. The auxiliary switchgear has been supplied by A. Reyrolle & Co. Ltd., and Edward Holmes Ltd., and the auxiliary transformers by Bonar Long. The whole of the lighting equipment has been supplied and installed by Gooder Electrical Co. Ltd., Auckland, N.Z. Comprehensive telecommunication systems are provided, including a normal P.A.X. with facilities for connection to the Post Office system, and to both wired and power line carrier systems of the electricity department. In addition, an operational interphone system gives direct speech at will between key points in and around the station as necessary for the control of the station plant.

The main 110-kV switchgear, together with the generator step-up transformers, is erected in an outdoor fenced enclosure, south of the station, conveniently situated for connection to the main 110-kV transmission lines, which accept the major part of the station output. There is, in addition, a 33-kV substation within the enclosure, which supplies the local power board and also the station auxiliary power. The main switchgear was also supplied by A. Reyrolle & Co. Ltd., and the transformers by Siemens-Schuckertwerke A.G. The complete busbar and isolator structure was supplied by the Canterbury Engineering Co. Ltd., Christchurch, N.Z.

The station is situated in a rural farming area some distance from the nearest township, so that a new permanent village has been required for the station operating staff. Some 150 new houses, together with a school, hostel, recreational and other facilities have been built by the Ministry of Works, and will be extended as required. In addition, temporary accommodation for some 1,200 men, including a considerable number of families, has been required during the construction period, and virtually the whole of this work, including the very substantial canteen and other domestic arrangements, has been provided for under the site contract.

Conclusions

In conclusion, we record our acknowledgements which are due to the New Zealand Electricity Department for granting us permission to publish this description, and to Messrs. Preece, Cardew and Rider for supplying much of the technical information, together with some of the illustrations.

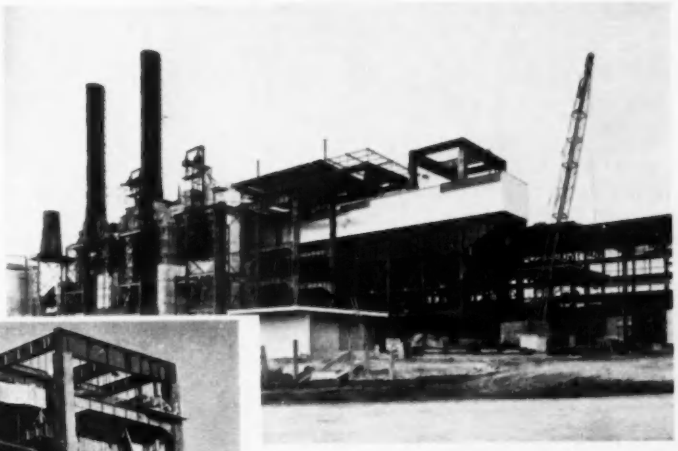


Fig. 12 (above). Constructional view during erection of boiler house, bunkers and turbine house steelwork.

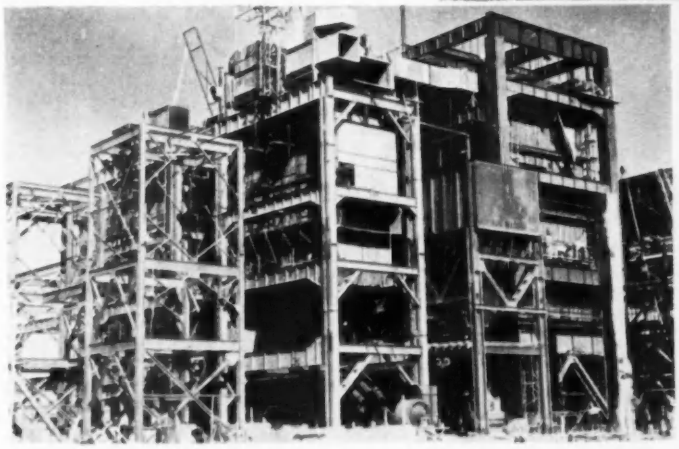


Fig. 13 (left). Close-up view during erection of boiler house steelwork and bunkers.

120-MW SET COMMISSIONED

The largest generating unit yet installed by the Central Electricity Generating Board of 120-MW capacity has been brought into operation at Blyth " A " power station, Northumberland. It is the first of four giant machines with which this power station will be equipped. When all four units are operating, the associated unit boilers will consume approximately one million tons of coal a year. The newly-commissioned generating set is expected to be the most efficient yet in operation in Britain. The building of a second station to be known as Blyth " B " is already authorised, and this will contain even larger generating sets, viz.:—of 275-MW capacity.

Some Factors Affecting the Performance of Condenser and Heat Exchanger Tubes

By P. T. Gilbert, Ph.D., F.R.I.C., F.I.M.*

AT a meeting of The Institute of Metals, Scottish Local Section, held in Glasgow on December 8th, 1958, Dr. P. T. Gilbert presented a paper under the above title. In his opening remarks he reminded his audience that for a number of years the corrosion of condenser tubes had presented important and baffling problems. These had been largely overcome, and the work that made this possible represented a fascinating episode in the history of corrosion science. He went on to say that corrosion of condenser tubes was not, however, a thing of the past. Trouble still occurs from time to time, and though this is usually for reasons which are not difficult to discover, there are certain problems which cannot yet be said to be fully solved.

Dr. Gilbert divided his talk into two parts, dealing first with the performance of tubes from the point of view of corrosion, and then with performance in the sense of the efficiency with which the condenser or heat-exchanger performs its function. There was no sharp dividing line between these two aspects; they were closely related and it is frequently found that when the efficiency is high the life of the tubes is long, whilst poor operational performance is not unusually accompanied by premature tube failures.

Corrosion by cooling water

The first problem considered was corrosion by cooling water. Normally, cooling water passes through the tubes, though in a few instances it circulates outside the tubes. Whether the water passes through or round the tubes the principles remain the same. Cooling waters may vary from the purest of distilled or demineralised waters to full-strength sea water, or indeed waters that have concentrations of salts even greater than those present in normal sea water. Any water composition in between these extremes may be encountered, and the choice of tube alloy will, of course, depend on the water composition. Generally speaking, if a fresh water is involved, no serious corrosion problems are likely to arise. Such waters are normally handled with tubes of copper, 70/30 brass or Admiralty brass (70/29/1). If the water is brackish, or sea water, the usual tube materials are aluminium brass (76/22/2) or one of the cupro-nickel alloys, usually either a 10 per cent. nickel or a 30 per cent. nickel alloy. The difficulty, of course, is to draw the dividing line between the two types of condition. Experience has shown that a useful arbitrary division can be made at a total dissolved solids content in the water of about 2,000 p.p.m. If the water contains more dissolved matter than this for an appreciable proportion of the running time, it is advisable to use aluminium brass or a cupro-nickel alloy because of the risk of impingement attack on copper or the ordinary brasses. Other factors enter into the matter, of course, such as the nominal water speed and the degree of turbulence in the water as it enters the tube. The higher the speed and the greater the turbulence, the lower would be the degree of salinity of the water that would permit the safe use of ordinary brasses.

It is well known that materials such as copper and 70/30 brass have only moderate resistance to rapidly moving waters, particularly sea-water, being prone to suffer impingement attack. Cupro-nickel alloys have relatively poor resistance to impingement attack unless they contain the proper additions of iron and manganese. Resistance to impingement attack is due, of course, to the formation on the alloy in service of a strong, self-healing, protective film. Although the nature of this film on cupro-nickels is not fully established, there can be no doubt that the presence of iron in the alloy contributes in some way to the development of a stable film. There is a great deal of practical experience that suggests that iron is important in the case of aluminium brass also, though in this case, since iron is almost insoluble in the brass, it cannot be incorporated in the tube alloy, and has to be provided externally. The protective films on aluminium brass tubes that have given long and satisfactory service are always found to be rich in iron oxides from corrosion of ferrous components in the system. It is possible that the incorporation of iron oxides is incidental, but there is a large amount of circumstantial evidence showing that behaviour is less satisfactory in the absence of the iron.

This last observation indicates the need for a brief consideration of the effects of cathodic protection in water boxes. In power stations, merchant ships, and many other applications, water boxes are usually of cast-iron, and if these are unprotected or inadequately protected they will not only provide a source of iron corrosion products, but provide some measure of cathodic protection to tubeplates and tube ends. However, the life of water boxes can be a matter of concern, and protection may need to be afforded by coating and/or by cathodic protection. Effective coating by itself will remove not only an obvious source of iron corrosion products but also the cathodic protection for the tubeplates and tube ends, and experience has shown that these then suffer. Cathodic protection of water boxes using sacrificial anodes is open to a number of objections, most of which do not apply to properly designed systems using impressed current. Such systems will provide protection to tubeplates and tube ends as well as water boxes. Nevertheless, since there is evidence that iron corrosion products are beneficial in reinforcing the protective films on the tubes, it may be found necessary to provide corroding iron anodes in conjunction with the cathodic protection used. It is likely that practical trials will elucidate these points in due course. There are some

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circumstances, e.g., in oil refineries, where impressed current systems are considered undesirable and under such circumstances sacrificial anodes, if used in conjunction with aluminium brass or cupro-nickel tubes, should preferably be of wrought iron or mild steel. These will not effectively protect cast iron parts, of course, and suitable coatings would therefore also be necessary.

Dr. Gilbert then spoke briefly on the subject of dezincification, saying that it was some 35 years since Bengough & May discovered that dezincification of alpha (single phase) brasses could be inhibited by a small addition of arsenic (0.02-0.06 per cent.), and yet there are still people who make brass tubes that will dezincify and others who use them. Condenser or heat-exchanger tubes of 60/40 duplex-structure brass, in which arsenic is ineffective, are still made in some countries. In some ways, this is perhaps less indefensible than the manufacture of uninhibited single-phase brass tubes which also occurs. Some people in the U.S.A. have a preference for antimony or phosphorus additions, instead of arsenic, to prevent dezincification. While these additions appear to be effective, no clear advantage has been demonstrated for them, and, indeed, there is evidence that phosphorus can have disadvantages. For instance, work by the British Non Ferrous Metals Research Association has shown that in some circumstances, phosphorus can impart a susceptibility to severe intercrystalline corrosion.

Dr. Gilbert then spoke of the serious problem of polluted waters.

Water in many harbours and estuaries is liable to be badly polluted and on occasions dissolved oxygen disappears, following which sulphate-reducing bacteria produce hydrogen sulphide. Under these conditions it is obviously not to be expected that the protective oxide films, on which the tubes depend for their good performance, can be produced or maintained. In fact, sulphide films develop that are non-protective, and indeed there is evidence that the sulphide deposits behave cathodically towards the underlying metal and stimulate corrosion at the many gaps and dis-continuities where the metal is exposed. As is to be expected, no copper-base alloy is entirely immune to corrosion under these conditions, and the only material, apart from the noble metals, that is unaffected appears to be titanium.

The most striking feature of corrosion in polluted waters is the inconsistency of the results obtained. Different orders of merit for the various alloys are obtained at different sites and even at the same site at different times. Part of the inconsistency is due to the fact that the initial conditions of exposure greatly influence the subsequent behaviour. Tubes that are exposed at the outset to clean water build up protective films that confer appreciable resistance if polluted waters are subsequently encountered. Such tubes are likely to last much longer than similar tubes exposed to polluted waters immediately they enter service. A notable source of rapid failure in some cases has been dredging in the vicinity of the condenser inlet, resulting in the passage of mud through the condensers. This is especially harmful if it coincides with the introduction into service of new tubes. It is also very important where polluted waters are involved, to avoid, as far as possible, leaving stagnant water lying in condensers.

General experience is that in polluted waters the cupro-nickel alloys give the best results; sometimes the 70/30 alloy is rather better than the 90/10, and in other cases the reverse applies. Admiralty brass sometimes gives surprisingly good results in estuarine waters, the attack occurring being fairly uniform so that a more general wastage occurs than with some of the other materials. Aluminium brass is liable to suffer deep pitting and is not normally recommended for use where the water is known to be polluted. Nevertheless, there are some power stations using very badly polluted water where aluminium brass gives four or five years service, which is as much or more than is obtained from any other alloy.

Research is in progress to develop condenser tube alloys that are more resistant to the action of polluted waters than the materials now available. One approach is to devise an alloy on which such attack as does occur is spread entirely uniformly over the surface so that pitting is eliminated. There are indications from work at the B.N.F.M.R.A. that it may be possible to achieve useful results along these lines. Apart from the search for new or modified alloys, much can be done to minimise the effects of polluted waters by appropriate operational procedures as indicated above. The most promising measure of all, however, is the introduction of a recently invented system of continuous mechanical condenser tube cleaning, known as the Taprogge system (British Patent No. 700,833). By continuously removing harmful scales and deposits, this system removes the conditions under which pitting attack occurs. There is every prospect that the use of this system will largely eliminate one of the few remaining major condenser tube corrosion problems.

The next problem considered by Dr. Gilbert was the abrasive action of sand particles suspended in the cooling water. The problem had assumed greater proportions in power stations on the Severn estuary and some parts of the Bristol Channel coast than anywhere else in this country. The continued passage of water containing suspended abrasive particles can produce a surprisingly rapid thinning of all the ordinary condenser tube materials. As would be expected, this wastage is most marked at the inlet ends and to a lesser extent at the outlet ends, but, except with the special alloys developed for this service, there is also attack throughout the length of the tubes. When this problem first arose at Portishead power station in the early 1930s, all conceivable condenser tube materials were tested and exhaustive trials continued for several years. It was eventually established that the only really satisfactory material was a special copper/30 per cent. nickel alloy containing 2 per cent. each of iron and manganese, developed by The Yorkshire Copper Works for this service. Subsequently it has been found that high tin bronze (12 per cent. tin) also has good resistance to sand erosion. At some power stations appreciable thinning occurs at the tube ends even with the special cupro-nickel alloy. This attack does not extend for more than a few inches from the tube end, however, and by the use of protective inserts it is possible to obtain reasonable tube life. Experience at these stations has demonstrated clearly that the alloy containing 2 per cent. each of iron and manganese was much superior to the more normal 30 per cent. nickel condenser tube alloy containing not more than 1 per cent. iron and 1.5 per cent. manganese.

Apart from the selection of tube alloy, trouble can be minimised by ensuring that the water passing through the condensers contains as little suspended matter as possible. Much can be done from this point of view by appropriate positioning of cooling water inlets and outlets, the provision of settling ponds, etc. Most of these steps have to be taken at the planning stage, however, and once the site works have been completed and the condenser is operating there is obviously much less scope for modification of the cooling water arrangements.

The final aspect of cooling water corrosion discussed was intensive local pitting which sometimes develops on the water side at points corresponding with a local high-temperature on the outside of the tube. This type of attack is unusual but not unknown in steam condensers, and is more often seen in bundles cooling or condensing petroleum products in oil refineries. Excessive local temperatures may be attained opposite vapour inlets, where the hot vapours impinge directly on to a few tubes. Cases are also known in which corrosion pits on the water side corresponded with the positions of baffle plates. In such cases the baffles are acting as extended heating surfaces so that the temperature at their point of contact with the tubes is slightly higher than elsewhere. It has been possible to reproduce this type of attack in the laboratory by applying a local source of heat to the outside of a tube specimen while passing sea water through it. The results obtained have been in line with service experience and show that the materials most resistant to this type of attack are aluminium brass and 90/10 cupro-nickel. Admiralty brass is more susceptible to attack than aluminium brass and 70/30 cupro-nickel more susceptible than 90/10 cupro-nickel. With the 70/30 cupro-nickel alloy the pits produced are often filled with metallic copper giving an appearance analogous to a dezincified brass tube. It is obvious that the main way of overcoming this type of trouble is to avoid the local extreme variations of temperature that produce the hot spots, by suitable baffling of vapour inlets, proper distribution of incoming vapour, etc.

Corrosion in steam spaces

Normally there is very little corrosion on the steam side of steam condensers, although occasional failures do occur due to impingement at high-velocity of wet steam carrying water droplets. This erosive action affects only a few tubes in the vicinity of the steam inlet and can be countered by fitting baffles, plugging affected tubes and leaving them in position, or fitting solid rods instead of tubes in the area involved.

Trouble on the steam side is perhaps more common in conditions quite the reverse of those producing steam erosion, i.e., in places where stagnation occurs. In some equipment there are spaces where there is little flow of steam, where incondensable gases can collect. Dissolution of oxygen, carbon dioxide and/or ammonia in the condensate can give rise to solutions that are corrosive towards copper alloys. Trouble is likely to be aggravated if the tube spacing is excessively close so that condensate "bridges" can develop between tubes, and corrosive solution is maintained in contact with parts of the tube surface for long periods. This type of corrosion has been experienced in the air extraction section of condensers, but is more common in distilled water evaporators, sugar evaporators and the like. The main remedial measures are to provide adequate vents to remove incondensable gases and to ensure that as far as possible steam sweeps all areas leaving no stagnant pockets. The most resistant of the usual alloys to incondensable gas corrosion is 70/30 cupro-nickel, and 90/10 cupro-nickel and aluminium brass are also better than copper or the ordinary brasses.

A further type of corrosion on the steam side of a heat-exchanger concerns high-pressure feed-heaters. In a number of cases severe attack has been observed on 80/20 or 70/30 cupro-nickel tubes in high-pressure heaters. This takes the form of general corrosion with the formation of an exfoliating scale consisting essentially of a mixture of metal oxides in the same proportions as the metals are present in the tube alloy. The attack has been observed only on heaters operated intermittently and its mechanism is, as yet, obscure. The only remedy at the present time, assuming continuous operation of the heaters not to be possible, is to use tubes of copper, which material is immune to attack, or, if this is not strong enough, 90/10 cupro-nickel on which the rate of attack is negligible.

Dr. Gilbert next discussed corrosion by petroleum products as experienced in condensers, coolers and heat-exchangers used in oil refineries. Finally, in this first section of his paper he mentioned briefly stress corrosion and corrosion fatigue, drawing attention to a paper* in which these problems were discussed in some detail.

Factors affecting operational performance

In the second part of his paper, Dr. Gilbert considered performance from the point of view of operational efficiency, the general theme being that the greater the uniformity of conditions the better will be the performance. The first requirement in a condenser or heat-exchanger is to transfer heat as efficiently as possible. It is not always realised that the thermal conductivity of the metal plays only a relatively small part in the overall heat transfer coefficient. Of greater importance are the films of practically stagnant condensate on the steam side, and cooling water on the other side, with the films and scales of corrosion products and deposited solids on both sides. On the other hand the effect of the differing thermal conductivities on the various alloys is by no means negligible, as is sometimes assumed. Thus the thermal conductivity for aluminium brass is about three times that for 70/30 cupro-nickel and under normal operating conditions, for example with clean sea water as the coolant, this is reduced to about a 10 per cent. advantage in favour of aluminium brass. The fact that it is possible to design a condenser with 10 per cent. less condensing surface when using aluminium brass tubes instead of 70/30 cupro-nickel is a powerful reason for choosing the brass whenever possible, in addition, of course, to the considerable price advantage.

Dr. Gilbert then discussed the distribution of cooling water, saying that to achieve the best results involves proper design of the water boxes and water inlets and outlets, together with considerations of the relative merits of single-pass and multi-pass units, etc. He did not deal with this aspect in detail, considering that it was sufficient to add that proper distribution of cooling

* "*Non-Ferrous Tubes in the Stress of Modern Conditions*" —*C. Breckon and P. T. Gilbert.* "*Metal Industry* 1958," *Vol.* 93, *pp.* 89-92, 114-116.

water is not only beneficial to performance, but by eliminating excessive local turbulence on the one hand and local overheating on the other is also beneficial in minimising the risk of the development of corrosion troubles. He then continued with the subject of tube cleaning.

Condenser tube cleaning may be carried out either chemically or mechanically. When the scales to be removed are essentially deposits from the cooling water, such as calcium and magnesium salts, acid cleaning may be appropriate and is not likely to have a harmful effect if properly carried out. The usual solution is one of 5-10 per cent. hydrochloric acid containing an inhibitor to prevent attack on ferrous components in the system. This should be thoroughly washed out after cleaning is complete and the condenser filled with a mild alkaline solution to neutralise any residual acid, followed by further washings. If the tubes are appreciably corroded, acid cleaning can be undesirable, since sparingly soluble cuprous chloride is likely to remain in the pits, with the result that these areas become even more active than before, when the condenser is returned to service. If acid cleaning of corroded tubes is essential it is preferable to use instead of hydrochloric acid a solution of 5 per cent. sulphuric acid containing about 0.02 per cent. potassium permanganate, or to follow the hydrochloric acid cleaning by treatment with a permanganate solution to oxidise residual cuprous chloride.

Manual cleaning is best carried out by using bristle or nylon brushes, or " bullets " can be passed down the tubes using compressed air, or preferably air and water. For obvious reasons harsh wire brushes should be avoided. The aim should be to keep damage to the tubes and to their protective films to a minimum. There can be little doubt, Dr. Gilbert suggested, that from all points of view the best method of tube cleaning is the recently invented Taprogge system of continuous and automatic cleaning by the circulation of soft sponge rubber balls.

The balls, which are porous, have a density of about one when filled with water, and they are injected to form a homogeneous mixture with the cooling water. Consequently, all tubes which have water flowing through them receive cleaning balls. The balls initially have a diameter about 10 per cent. greater than the diameter of the tube, and have to be replaced at intervals owing to wear. The number of balls for, say, the condenser associated with a 30-MW generating set would be of the order of 300, and circulation would not normally be necessary for more than eight hours in every twenty-four. Many units are in use on the continent of Europe and others are coming into use in this country, the U.S.A. and other parts of the world. Without exception those in service have proved extremely effective in keeping the tubes clean and maintaining high heat transfer rates, and, moreover, the saving of fuel resulting from improved vacuum has in all cases paid for the capital cost of the equipment in a very short time. There is the additional advantage, mentioned earlier, of the elimination of the conditions under which pitting can occur in polluted waters.

Under conditions of severe sand erosion, it is necessary to tolerate a certain reduction in heat transfer rates, which is contrary to what might be expected at first sight. Although the sand keeps the tubes clean, the alloy that must be used to resist the abrasive action developes a tough film of appreciable thickness, and this inevitably interferes to some extent with heat flow. But for the presence of this film the tubes would wear away quickly, so that the only alternative to slightly reduced efficiency is short tube life.

Factors concerning steam or product side

Before dealing with this subject, Dr. Gilbert again stressed that uniformity of conditions throughout the bundle is most desirable, and the objective should be to make every tube perform its proper share of the work. It is not sufficient merely to pack the maximum number of tubes into the minimum of volume as seems to have often been done in the past. There should be provision for vapour to get to the tubes in the interior by the proper spacing of tubes. If vapour is to get to all tubes, more space is needed for its passage the nearer the inlet is approached, and it is, therefore, obvious that the tubes nearest the steam or product entry should be more widely spaced than those further away. Widening the spacing is often not enough, however, and it may be necessary to provide steam or vapour lanes. If some tubes in a bundle are operating at a much higher temperature than others, inefficient operation will not be the only undesirable feature. For example, if the tubes are expanded into tubeplates at the ends, considerable unbalanced stresses may be introduced leading to failures by stress corrosion or corrosion fatigue.

There would appear to be little doubt that one of the biggest mistakes in the design of tubular condensers and heat-exchangers is to use too many tubes. There have been many instances where equipment from which an appreciable proportion of the tubes has been removed has been found to work more efficiently after modification.

In conclusion, Dr. Gilbert mentioned the improvement of heat transfer rates in steam condensers by the promotion of drop-wise condensation. This is achieved by adding to the steam small amounts of organic compounds which prevent the condensate from wetting the tube surface. The condensate thus immediately runs off in drops instead of forming a continuous film. The main difficulty is to produce a lasting effect, since obviously expensive organic materials cannot be added continuously. A considerable degree of success has now been attained, notably by the workers at the Mechanical Engineering Research Laboratory. If this development comes into practical use it will more than ever be necessary to design condensers so that steam can readily reach all the tubes.

CONVENTION ON THERMO-NUCLEAR PROCESSES

One of the most significant of recent developments has been the prospect of harnessing thermo-nuclear power for peaceful purposes. In recognition of the important part which Britain has played in this field the Institution of Electrical Engineers has arranged a convention on thermo-nuclear processes which is to be held in London on April 29th and 30th, 1959. In view of the rapidity with which the subject is developing details of the programme have not yet been completed, but the probable range of topics to be covered will be basic physics of thermo-nuclear processes, prototype British thermo-nuclear experiments, constructional features of ZETA I, design problems in future ZETA type systems, and possibilities of direct conversion from nuclear to electrical energy. Reviews of related work in the United States and the Soviet Union will also be included in the programme. Further particulars and registration forms are available from the Secretary of the Institution at Savoy Place, Victoria Embankment, London, W.C.2.

An Evaporatively Cooled Engine

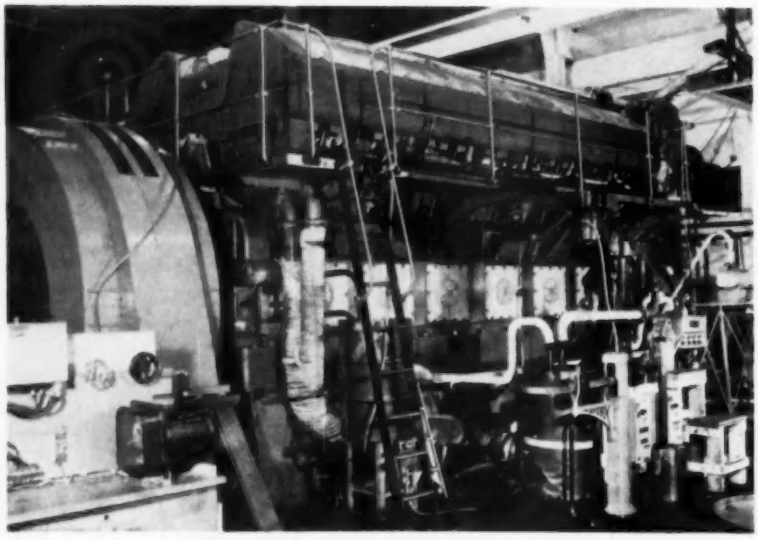
THE normally accepted method for diesel engine cooling is a closed-circuit with maximum temperature at the engine jacket water-outlet of 180 deg. F., and heat dissipation via a heat-exchange unit. There are, however, certain benefits to be obtained from high-temperature cooling on an evaporative cycle. For example, the engine, regardless of load, maintains a constant circulating-water temperature; when operating at high-temperatures there is no possibility of the exhaust-gases falling to below their dew point (this having the effect of decreasing the cylinder liner wear); and when using heavy fuel-oil in the region of 3,500 sec., greater thermal efficiency is obtained, and steam produced by the steam separator can be used for heating the fuel to its correct viscosity for combustion. Considerable research and experimental work on this type of evaporative cooling has been carried out by Mirrlees, Bickerton & Day Ltd. (a member of the Hawker Siddeley Group), and an installation comprising one of the company's KSS6-cylinder diesel engines equipped for high-temperature cooling has for some time operated successfully in a Belfast factory. The company have also obtained an overseas contract for two of their KV-type engines running on an evaporative cooling cycle, with a water outlet temperature of 250 deg. F., corresponding to a steam pressure of 15 lb./sq. in. No circulating pumps are to be incorporated, the contract requirements being for the engine to operate with a thermo-syphon jacket, or natural circulation, cooling-water circuit.

The engines concerned are of the company's KVS12-type, capable of developing 2,724 b.h.p. at 450 r.p.m. They will be directly coupled to alternators, manufactured by Brush Electrical Co. Ltd., with an output of 1,750-kW, 2,187-kVA at 0.8 p.f., 4,160-V, three-phase, 60 c/s. The engine, of vee form, has twelve cylinders of 15-in. bore by 18-in. stroke, a compression ratio of 11.35 to 1 and a brake mean effective pressure of 126 lb./sq. in. It is a totally enclosed four-stroke, solid injection, four valves per cylinder unit fitted with two Brush air-cooled turbo-chargers and capable of maintaining a two-hour overload rating of 110 per cent. Each bank of six cylinders will have its own steam separator; the circuits of the two banks operating quite independently of each other. Water level will be automatically-controlled by means of Mobray electrically-operated water-level units operating their own ram-type make-up feedwater pumps.

Briefly, the evaporative circuit operates on the principle that heat is given up to the engine circulating-water until it reaches a predetermined temperature governed by the steam pressure. The engine jacket water circulates in a closed system to a steam separator where, due to a drop in pressure, it "flashes off" in the form of steam, thus removing the excess B.Th.U.'s in the form of latent heat. The temperature of the circulating-water will vary between 212 deg. F. at atmospheric pressure, or can be increased to a maximum of 250 deg. F. (15 lb./sq. in.). Steam at 15 lb./sq. in. can obviously be used for a number of purposes, but on this particular contract it is being utilised for sea-water distillation, and to raise the temperature of heavy fuel-oil.

Test rig at Stockport works

We were recently invited to inspect one of these units undergoing prolonged tests at the Stockport works of Mirrlees, Bickerton & Day Ltd., where for this purpose the company has installed two separate condensers to deal with the steam from the steam separators. The condensate from each condenser is bled to a separate feed-tank and pumped back into the engine water-jacket circulating system by the ram-type pumps. The engine is fitted with a Westinghouse governor—a combined electrical and mechanical unit—the mechanical components of which consist of a combined actuator and hydraulic power pump mounted directly on the engine, in place of the conventional governor. An electric control panel, mounted in the main switchgear, contains instruments to measure generator frequency, generator load and engine fuel rack position. These circuits are fed into a magnetic amplifier totaliser which in turn passes a signal to the hydro-mechanical actuator system. The actuator receives signals from the electric control unit and converts a pressure from the hydraulic supply to proportional forces. These forces work in the actuator to position engine fuel-pump control gear

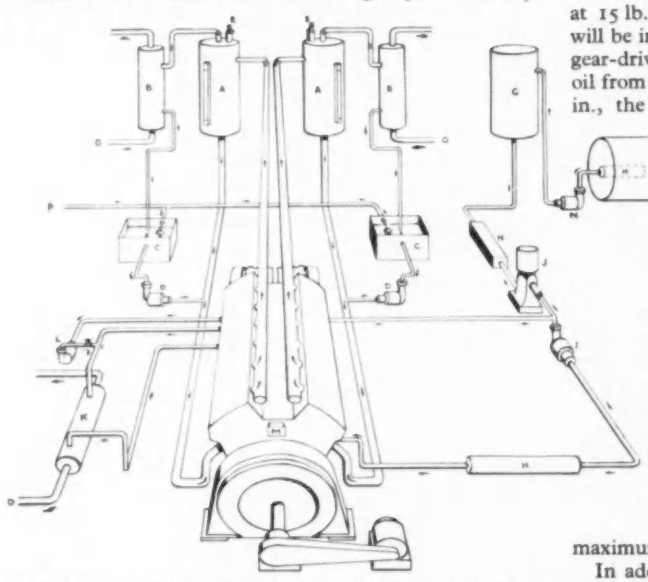


"KVS 12" Mirrlees engine fitted with high-temperature cooling on an evaporative cycle, undergoing tests at the Stockport works of Mirrlees, Bickerton & Day Ltd.

according to load demands. The governor performance has a steady constant speed ranging from 'no load' to 'full load' and vice versa, of ± 0.3 per cent. Any momentary speed change when the load is suddenly changed from 'no load' to 'full load,' or vice versa, will not exceed ± 3 per cent.

In the event of additional steam being required at site, an exhaust-gas boiler, designed for a steam pressure of 200 lb./sq. in., has been incorporated. Any excess from the high-pressure steam line will be passed through a reducing valve and be fed into the low-pressure system at 15 lb./sq. in. With this system of heat recovery, an overall thermal efficiency in the region of 80 per cent. may be obtained.

The engine is operated on 3,500 sec. fuel, and for the purpose of the tests being carried out, centrifuge equipment and electric heaters have been installed in series to give the correct operating temperature of 230 deg. F. Under site conditions, the engine will operate on heavy fuel-oil which will be fed to the injection pumps at a pressure of 40 lb./sq. in. In the event of this oil supply pressure falling below 15 lb./sq. in., normal diesel fuel-oil will be automatically fed through to the fuel racks at 15 lb./sq. in., by a gear-driven fuel-oil pump which will be in constant operation. The engine is fitted with a gear-driven fuel-oil circulating pump, which will transfer oil from the daily service tanks to the engine at 15 lb./sq. in., the heavy oil taking over only when a pressure in excess of this figure is reached or, alternatively, in the event of the heavy oil supply pressure falling below this amount the diesel oil supply will come into operation. A sea-water cooled heat-exchanger will be provided to maintain the lubricating oil at a maximum temperature of 170 deg. F.



Diagrammatic arrangement of Mirrlees "KVS 12" engine and associated auxiliary equipment.

Key:—
A Steam separators
B Condenser
C Condensate and make-up tank
D Feed pump
E Safety valve
F Heavy fuel storage tank
G Heavy fuel daily service tank
H Heavy fuel heaters
I Heavy fuel circulating pump
J Heavy fuel purifier
K Lubricating oil cooler
L Automatic standby lubricating oil pump
M Westinghouse governor
N Transfer pump
O Raw water
P Make-up

In addition to the standard protection gear consisting of overspeed and low-lubricating oil-pressure trips, which are mechanical features, arrangements have been made for alarms to operate in the event of the lubricating oil temperature rising to 180 deg. F., and the pressure falling to 12 lb./sq. in.

The two units at present being completed will be supplied to the United States Information Agency (Voice of America), and they are believed to be the largest in which evaporative cooling has been employed.

HEGAFILM

One of the latest developments in water treatment to be introduced into this country by Albright and Wilson (Mfg.) Ltd., is Hegafilm. Hegafilm is a registered trade mark of Albright and Wilson (Mfg.) Ltd. The new material is a long-chain amine used for improving heat transfer and preventing corrosion in condensate systems. By forming a non-wettable film, Hegafilm controls corrosion of process heaters, space heaters, evaporators and condensate lines. Improvement of heat transfer when using this material is obtained because it keeps surfaces clean and promotes dropwise condensation. Many paper and board mills have reported an increase in production since using this process. The main constituent of Hegafilm is Octadecylamine, but there is a proportion of amines with shorter chain lengths which help to give protection over a wide range of conditions. It can be used in plant on continuous load but is particularly useful when there is intermittent use, as protection is given during stand-by periods. Treatment of multiple-effect evaporators, although relatively new is a promising application. Here tube replacement costs can be reduced and heat transfer improved. Hegafilm has a dispersing action on iron oxide deposits which can be turned to good account in cleaning up a system and so promoting better heat transfer. Except in a new system, however, it is advisable to start treatment with a low feed to produce gradual rather than rapid removal of deposits. Hegafilm should preferably be introduced into the feed line after the de-aerator or feedwater heater. Alternatively, it can be fed into the steam line, especially if only part of the system requires treatment. Other possible feeding points are evaporators, condensate receivers and boiler drums. Data sheets are available, and can be obtained from the Alkali Phosphates Department, Albright and Wilson (Mfg.) Ltd., 1, Knightsbridge Green, London, S.W.1.

For the first section of their new Rooiwal power station, the City Council of Pretoria have placed contracts with the English Electric Company (South Africa), for two 60-MW turbo alternators, and with Yarrow (Africa) (Pty.) Ltd., for two 550,000 lb./hr. pulverised-fuel-fired boilers. The value of these contracts is approximately £2,800,000 and the major part of the equipment will be supplied from this country by the English Electric Co., Stafford, and Yarrow & Co. Ltd., Glasgow. Merz & McLellan, of London and Newcastle upon Tyne are the consulting engineers for the Council.

"Power for the Future" is the title of a booklet published on December 16th, 1958, by The Electricity Council, which is now the central body representing the whole of the electricity supply industry in England and Wales. Prepared in connection with the Electricity (Borrowing Powers) Bill and forming a sequel to the similar publication, "Power and Prosperity," of the former British Electricity Authority in 1954, the booklet outlines the development of electricity supply in the past and gives an estimate of the rise in demand over the next few years.

Boiler Plant for Nestles New Factory

A NEW factory for the production of chocolate confectionery has been built for Nestles Ltd., on part of a site of approximately 19-acres, acquired by the company at Mickleover, Derbyshire. Building commenced in October, 1956, and the factory, with an area of 77,000 sq. ft., is now completed. It is expected that approximately 300 local people will be employed there, and the company anticipate that further production buildings and plant will become necessary in the near future.

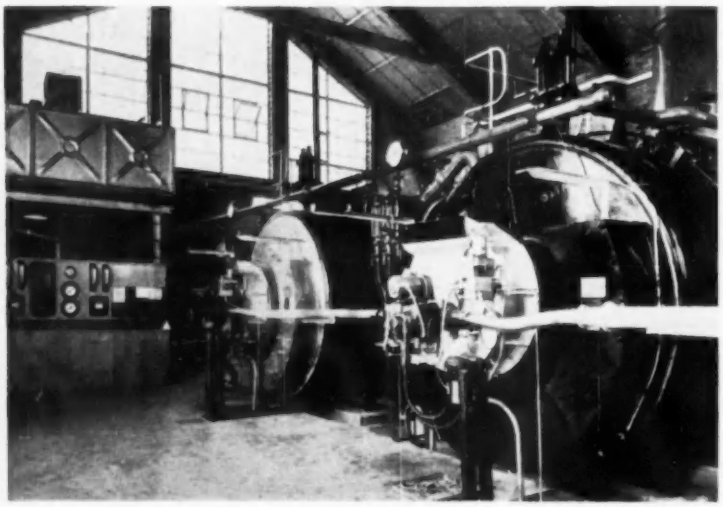
Steam for both space-heating and works process requirements, together with that necessary to heat a domestic hot-water supply to the new factory, is provided by two Super Economic boilers, supplied and installed by John Thompson (Wolverhampton) Ltd., each with an evaporative capacity of 6,000 lb./hr. at 200 lb./sq. in., with feedwater at 180 deg. F. The boilers are fired with 3,000 secs. fuel-oil, but are so designed that a change-over to coal-burning could be made if required. The necessary equipment—comprising two travelling chain-grate stokers, supplied by John Thompson (Triumph Stokers) Ltd., is, in fact, stored on the premises. Each boiler is 8-ft. diam., and 17-ft. 6-in. long over the combustion-chamber; the boiler flues, (one for each unit), being 3-ft. 10-in. diam. The smoke-box for each boiler is, of course, designed to be suitable for either oil-burning or stoker-fired operation. The boiler shells, including the shells of the combustion chambers, are insulated with a 2-in. thickness of an 85 per cent. magnesia compound.

Fuel-oil is delivered by road tanker and pumped into either of two 10,000 gall. capacity storage tanks, in which the oil is maintained at a temperature of 130 deg. F., by a steam heating system, the pipework for which was manufactured by John Thompson Pipework Co. An electric heater is provided as standby. From the storage tanks, oil is gravity-fed to a pumping and heating unit specially designed by Thermal Units Ltd., and which comprises a steam/electric oil preheater and two electrically-driven circulating pumps, which have a combined capacity of 360 gall./hr. The preheater, operating at 100 lb./sq. in., increases the oil temperature to 180 deg. F., and on the steam side of the unit is capable of heating 180 gall./hr. On the electrical side, which is rated at 7.5-kW, it can heat 60 gall./hr. The fuel oil is supplied to the burners through a ring-main assembly at a pressure of 5 lb./sq. in. The heating and pumping unit, together with all the boiler auxiliary plant, is capable of servicing a further boiler, if this should be installed at a later date.

The oil burners themselves are of the "Hydra" rotary-type, supplied by Hydran Products Ltd. Each burner incorporates a built-in metering mechanism to measure, by volume, the fuel-oil delivered to the rotary cup. This arrangement is claimed to respond with considerable flexibility to the modulating control installed to ensure that the oil, the primary and the secondary air are correctly proportioned over the wide turn-down range which the plant provides. Should a pressure rise occur with the flame in the minimum position, the plant is automatically switched off, and can only be re-ignited following a pressure drop, and only in the low-flame position.

The installation is provided with two induced-draught fans, supplied by Musgrave & Co. Ltd., each driven by 7½-h.p. totally-enclosed, fan-cooled, squirrel-cage motors, running at 1,450 r.p.m. From each fan outlet, $\frac{5}{16}$-in. mild-steel ducting connects to a single chimney constructed of ¼-in. and $\frac{5}{16}$-in. mild steel, and which has a base diam. of 9-ft. 3-in., and a height of 60-ft. Each boiler is equipped with two hand-wheel operated 4-in. thrust-type soot-blowers, which are positioned through the backplate of the combustion chamber, and one jet-tube soot-blower entering the boiler at the side of the smokebox. All these blowers were supplied by the Diamond Blower Co. Ltd.

Feedwater is obtained from the town supply, and is chemically-treated in a vessel placed immediately above the 1,800 gall. capacity feedwater tank, from where it is gravity-fed to a steam-driven, single-cylinder, direct-acting type pump, capable of delivering 2,000 gall./hr. of water, and which was supplied by G. & J. Weir Ltd. A centrifugal pump, driven by a 15 h.p. totally-enclosed fan-cooled squirrel-cage electric motor, and capable of handling 50 gall./min. of water against a boiler pressure of 200 lb./sq. in., is provided as standby. Each boiler is fitted with a feedwater regulator,



The two Super Economic boilers each of 6,000 lb./hr. capacity, and which were supplied by John Thompson (Wolverhampton) Ltd.

supplied by Ronald Trist & Co. Ltd., which maintains a predetermined water-level in the boiler, by controlling the amount of feedwater distributed by the Weir pump.

The control panel associated with the new plant, was constructed by Thermal Units Ltd., and is of the console type, carrying a Simpelx Mono CO_2 recorder manufactured by James Gordon & Co. Ltd.; instruments for recording draught conditions at each boiler smoke duct outlet and at each furnace mouth, manufactured by John Thompson Instrument Co. Ltd.; and instruments for recording the level in the fuel-oil storage tanks, manufactured by K.D.G. Ltd. Controls are provided on the panel for the induced-draught fans, steam pressure, steam tracing, oil temperature, and oil circulating pump.

The steam-heated calorifiers, which supply the hot-water, are situated in the boiler house, the hot-water being pumped to the factory by two pumps, driven by 2-h.p. motors, running at 1,450 r.p.m., and supplied by the English Electric Co. Ltd. Process steam is delivered via a 30-ft.-long pipe-bridge, through 5-in. diam. pipes manufactured by John Thompson Pipework Co., who also supplied the auxiliary steam and blow-off steam pipework. The main steam piping is arranged in such a way that it terminates in a manifold from which distribution, at varying pressures, is controlled.

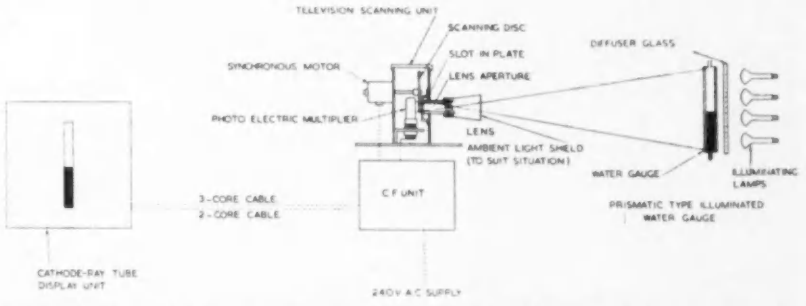
WATER-LEVEL TELEVISION EQUIPMENT

For the remote observation of water-level indicators, used with either the ordinary prismatic gauge of the "Bull's-eye" type, Hopkinsons Ltd., Huddersfield, manufacture television equipment which comprises a scanning unit, cathode follower unit (these two located together) and a display unit. The scanning unit houses a lens, scanning disc and photo-multiplier. The scanning disc has a narrow slot with variable radius, and is rotated at exactly the mains supply frequency by means of a synchronous motor locked to the mains period. An illuminator is fitted to the water-gauge, no external illumination being necessary. Light from the illuminator passes through the prismatic indicator in such a way that the steam space appears as intense clear light, and the water-column as dull diffused light. The light from the gauge passes through the lens in the scanning unit to a focal plane coincident with the scanning disc, in front of which is a fixed vertical slot. As the disc rotates, the disc slot and the fixed slot together, form a gate admitting light at all points along the fixed slot progressively with respect to time. Thus the gauge glass is "scanned" and the gated light is allowed to fall on the sensitive surface of a photo-multiplier.

The voltage produced is transmitted along a cable to the display unit, and is transformed back into light by the cathode-ray tube. Deflection of the beam of light on the cathode-ray tube is exactly synchronised with the scanning motion. The photo-multiplier is insensitive to the water-column in the gauge, since the main light from the illuminator, passing through water, is refracted outside the scope of the narrow vertical slot in the plate behind the lens, and the dull diffused light coming directly through the water-column is insufficient to activate the light-sensitive cell of the multiplier.

(Left). The scanner and amplifier for Hopkinsons' water-level television equipment.

(Below). Diagrammatic arrangement of water-level television equipment in a boiler installation.



G. & J. WEIR CHANGES

In pursuance of the resolutions of stockholders dated June 4th, 1958, the name of G. & J. Weir Limited was changed to G. & J. Weir Holdings Limited on December 31st, 1958. On the same date, the Cathcart trading undertaking was transferred to a new subsidiary company with the name of G. & J. Weir Limited, as given up by the parent company. The parent company will now operate as a holding company under the direction of the present board, as follows:—Hon. J. Kenneth Weir, C.B.E., B.A. (chairman), J. W. W. Drysdale, B.Sc. (deputy chairman), J. Russell Lang, N. M. Niven, Sir Charles Connell, M.A., J. A. Lumsden, M.B.E. Mr. John Davidson, F.C.I.S., secretary of the company, has retired and is succeeded by Mr. J. J. B. Young, C.A. The board of the new operating subsidiary company is as follows:—Hon. J. Kenneth Weir, C.B.E., B.A. (chairman), J. Russell Lang (managing director), J. W. Atwell, M.Sc., (deputy managing director), A. C. Smith, (sales), J. J. B. Young, C.A., (finance), Gavin Milligan, (works), R. S. Silver, D.Sc., (technical). The secretary of the new company is Mr. Harvey Waugh, F.C.I.S.

* * *

Tennessee Valley Authority have awarded **Ferranti Ltd.,** Hollinwood, a new contract for four 66,667 kVA, 60 c/s, single phase units to form a 200,000 kVA 3-phase, 154/69/13.2 kV bank with spare unit. The transformers are for the Alcoa switching station in Tennessee. The order is worth $486,816 and units are required on site by November 1st, 1959.

* * *

More than one quarter of the coal used by the **Central Electricity Generating Board** in its power stations throughout England and Wales is transported by sea. This figure amounted to 11,600,000-tons during the year ended March 31st, 1958, and of this quantity the Board's own collier fleet carried 6,250,000-tons. The story of the work of this fleet is told in a new 16-mm. colour film, with sound commentary, and a running time of approximately 40-min., which is available on free loan from the Board.

RECENT Equipment AND Accessories

Mercuryless instrument for measurement of differential pressure

George Kent Ltd. announce the addition to their "Commander" range of the new Kent-Barton mercuryless diaphragm instrument for the measurement of differential pressures in six maximum ranges, and up to 2,500 lb./sq. in. working pressure. Available as circular-chart recorders, sector-scale indicators and circular-scale indicators, these instruments incorporate the "Barton" patented rupture-proof differential unit, which, although employing sensitive bellows for its actuating element, may be subjected to pressure differences equivalent to the pressure rating of the instrument without damage. Full line pressure can be applied across the bellows unit in either direction without damage, irrespective of the differential-pressure range of the instrument, owing to the valve in each bellows. The torque-tube drive

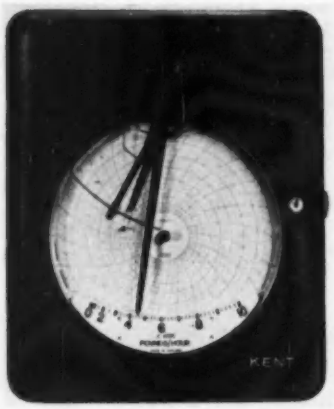


Fig. 1 (left). The new Kent-Barton mercuryless instrument, shown here as a flow recorder-controller, with crescent-scale indication. (George Kent Ltd.)

for conveying bellows movement to the instrument-index mechanism is said to be leakage-free and to require no periodic lubrication. Only the bellows exteriors are exposed to the metered fluid, and the unit is therefore completely self-draining or venting; is without pockets to trap condensates and sediment formations; and has no small tubes or other restrictions to interfere with its function. To these recorders and indicators for flow, level, specific gravity, etc., can be added—with certain limitations—additional measuring elements for pressure (Bourdon tube) and/or temperature (mercury-in-steel); also air-operated automatic control or transmission of the primary variable by incorporation of one of the new Kent "Mark 30" series of units. Other optional instrument functions are integration of rate-of-flow and, for recorders with crescent-scale indication. (*George Kent Ltd., Luton, Beds.*)

Proportional air-operated pressure controller

The new Mason Neilan (model No. 2807) air-operated pressure controller is normally used mounted

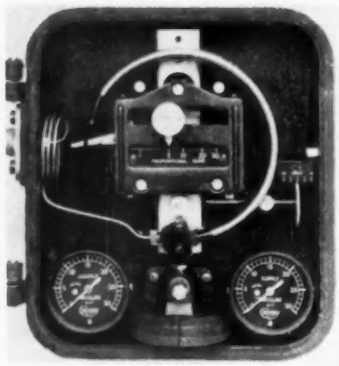


Fig. 2 (above). Interior of the new Mason Neilan air-operated pressure controller. (Crosby Valve & Engineering Co. Ltd.)

directly on the yoke of the control valve, but can also be used remotely surface mounted. Special features of the instrument include a pilot-relay of the non-bleed slack-diaphragm type which has a large air capacity and enables a much greater valve stroking speed to be achieved. The proportional mechanism incorporates a bellows-operated negative feed-back system giving maximum sensitivity and reproducibility. With this proportional mechanism, the proportional band can be adjusted as low as 1 per cent. of the instrument range, thus enabling the controlled pressure to be kept within very close limits even when wide load changes are experienced. The pressure element which is available in bronze or stainless-steel can be either of the bourdon tube or bellows type, covering all ranges from full vacuum up to 10,000 lb./sq. in. The instrument is exceptionally sturdy, simple to operate and maintain, is suitable for outdoor use in all climates, and will withstand over-pressure up to 50 per cent. of the range. The normal supply pressure is 20 lb./sq. in. with the International standard output signal of 3-15 lb./sq. in. (*Crosby Valve & Engineering Co. Ltd., Crosby Works, Ealing Road, Wembley, Middlesex.*)

Three-phase variable speed drives

The "Varimag" variable-speed drive manufactured by Lancashire

Fig. 3 (right). The Lancashire Dynamo Nevelin "Varimag" three-phase controller. (Lancashire Dynamo Nevelin Ltd.)

Dynamo Nevelin Limited (a member of the Lancashire Dynamo Group) has now been developed as a three-phase unit and is available for outputs up to 10-h.p. The drive comprises a speed controller and a variable speed motor. Basically, the controller is a magnetic amplifier giving a variable voltage output from a three-phase,

bridge connected, semi-conductor rectifier, the level of voltage being determined by the setting of a hand-operated potentiometer. The magnetic amplifier is connected in such a way that the armature voltage of the variable-speed motor is in constant balance with the reference obtained from the speed potentiometer. Any difference existing between these two levels of voltage results in a signal into the magnetic amplifier in such a direction as to correct for the error. The speed controller is an entirely static piece of equipment, of robust design, and for the larger outputs makes use of silicon semi-conductor rectifiers. The three-phase "Varimag" is available from 3-h.p. up to 10-h.p., and provides a speed range of 20/1. The variable-speed motor may be switched direct-on at any speed and any load, and will provide a speed regulation light load to full load of $\pm 2\frac{1}{2}$ per cent. The motor can be provided in protected enclosures or totally-enclosed. (*Lancashire Dynamo Nevelin Ltd., Oxted, Surrey.*)

A new chlorinator

Chlorination Equipment Ltd. announce the production of a new chlorinator in which extensive use has been made of plastic materials, specially developed for chlorine and water resisting properties, in the construction of components such as

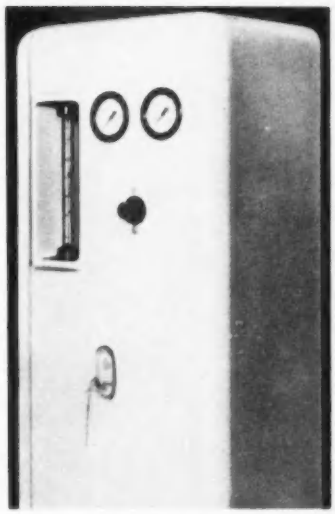


Fig. 4. The type N.A. chlorinator. (Chlorination Equipment Ltd.)

the injector block, chlorine regulator, valve body and piping. The cabinet is fabricated from polyester-impregnated glass-fibre and the necessity of periodical repainting is thus eliminated. The principal component of the new unit is the vacuum regulator assembly, which consists of the regulator and differential chambers. The flow of water under pressure through the injector produces a vacuum which extends to the differential chamber. This is connected to the vacuum regulator through the chlorine flow-meter and control valve. The throttling action of the latter reduces the vacuum, which is at 35-in. w.g. in the differential chamber to 20-in. w.g. in the regulator chamber, and the chlorine gas arriving there is reduced to this negative pressure. A constant differential thus exists for metering at any given reading. Manipulation of the control valve causes a float in an accurately calibrated glass tube constituting the flow-meter to take up a position adjacent to the required reading. The top side of the regulator diaphragm is connected to atmosphere, and the safety relief valves which it houses comes into operation in the presence of gas under pressure or an excess vacuum caused by failure of the chlorine supply. The provision of other devices prevents back flooding and also ensures safety in the event of failure of the vacuum regulator valve. The chlorinator, known as model CE, is available in thirteen meter sizes ranging from maximum capacities of 0.125 to 40 lb. of chlorine per hour with a control range of 10 : 1. It is produced in two types; type NM for manual operation and type NA for fully-automatic dosing. In the latter unit a vacuum transmitter is incorporated, which is responsive to changes in flow and transmits such changes to the chlorine regulator assembly by varying the differential pressure across the control valve. The vacuum for the operation of this device is produced by an auxiliary injector connected to the low-pressure water supply. The vacuum transmitter is available for operation by the differential taken from a venturi or orifice-plate, or from a float actuated by a weir or flume. (*Chlorination Equipment Ltd., 129, Kingsway, London, W.C.2.*)

Atomic energy temperature test rig

In order to obtain information which is considered to be essential to the improvement of atomic reactor instrumentation, a test-rig, incorporating the type of graphite blocks used in reactor construction, has recently been completed by the Foster Instrument Co. Ltd. for the United Kingdom Atomic Energy Authority. Extensive research tests were carried out by the Foster Instrument Company's experimental department, these tests including the measurement of temperature gradients in all planes through varying thicknesses of graphite, surface temperatures in the fuel element and isotope channels, and time constants of various types of thermocouples. These tests were carried out under both static and dynamic conditions, and under the latter, air flow rates of 37,000 to 87,000 cu. ft./hr. were required,

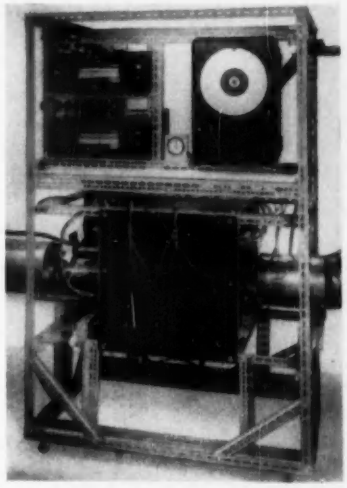


Fig. 5. An atomic energy temperature test rig similar to that recently completed for the U.K.A.E.A. (Foster Instruments Co. Ltd.)

necessitating the development of special types of contact thermocouples. The heat source was created from electrical blanket heaters on all sides of the block assembly and special cartridge and "vee-formed" heater elements mounted on dummy fuel cans. By controlling air flow rates and temperature, operational conditions representative of any section throughout the entire depth of the reactor were simulated. (*Foster Instrument Co. Ltd., Letchworth, Herts.*)

Speed-reduction pulleys

A feature of the Andantex unit now available from Furnival & Co. Ltd. is the method of keying the planet pinions to their respective shafts. This method has been invented mainly to overcome the difficulties experienced in equilibrating the load when more than one multiple gear train is fitted round the central sun gears. The pinions are mounted on their shafts and left free to rotate so that they can take up their natural position. Special adaptors are used in the position of the planet shaft bearings thus enabling the planet gears to be pre-loaded and set in their correct position in relation to the central sun gears. The pinions

are mounted on their shafts and left free to rotate so that they can take up their natural position. Special adaptors are used in the position of the planet shaft bearings thus enabling the planet gears to be pre-loaded and set in their correct position in relation to the central sun gears. This assembly now forms a mould which is preheated and liquid nylon is injected by a specially designed nylon injection press. The adaptors are then removed and the correct bearings inserted. Slight elasticity in the nylon allows the bearings to give the pinions sufficient working clearance and thus equilibrates the load upon them. All gears used in the manufacture of Andantex pulleys are of the single helical type made from nickel-chrome steel. Only ball and roller bearings are used, and the oil seals incorporated are of the highest quality. Several special accessories have been designed for mounting on to the side of the Andantex

Fig. 6 (left). Cut-away view of the new "Andantex" speed-reduction pulley. (Furnival & Co. Ltd.)

reduction pulley. These can act as torque limiters, as clutches, or as a means to obtain two separate speeds. The accessories form an integral part of the unit itself and therefore take up very little extra space. They can be so arranged that the drive is controlled remotely or by hand, ensuring positive predetermination of the safe working load. Another very important feature of the Andantex reduction pulley is the safeguard it provides when driving capital equipment, acting as a safety device against damage through overload or careless operation. The reduction pulley also provides a method of reversibility not dependent upon the addition of extra gears or the crossing of a belt. The direction of rotation is governed by the gear ratio employed and can, therefore, be arranged as required. The range of speed reduction obtained by using these units is very varied—21 set ratios are available ranging from 2.79 : 1 to 273 : 1 in cases where the driven shaft rotates in the same direction as the driving shaft. When the driven shaft rotates in the reverse direction the range is from 1.79 : 1 to 272 : 1. Andantex reduction pulleys are made in various sizes to transmit up to 80-h.p. (*Furnival & Co. Ltd., Reduction Pulley Division, Reddish, Stockport.*)

Transistorised level control

A new capacitance-operated level-control and indication equipment has been introduced by Lancashire Dynamo Electronic Products Ltd. Known as the T.L.C.1 (single-level) and T.C.L.2 (multi-level), the new equipment utilises transistor oscillators to replace oscillator valves in the detector circuit which registers the change in the capacitance at a probe or similar electrode on the approach or recession of a material. The equipment is integrated with a common form of probe head unit which will accept various electrode assemblies, these having configurations to suit the application. Maximum ease of maintenance is achieved by the use of printed circuit units. This common probe head unit accepts any of a number of probes designed to cover a maximum variety of industrial

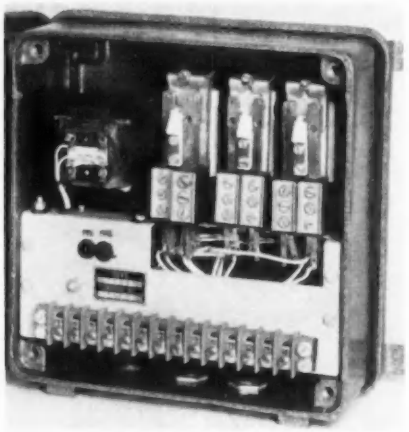


Fig. 7 (right). The T.L.C.2 multi-level controller, showing interior construction of remote-control unit. (Lancashire Dynamo Electronic Products Ltd.)

applications. Maximum probe current is 1 milliamp at 6 volts r.m.s. at a high frequency. The unit in sensitive form is capable of operating for changes of capacitance of ± 2 p.f. Excellent long term stability, and stability against supply voltage changes has been proved. Operation is satisfactory at ambient temperatures up to 50 deg. C. The equipment is substantially independent of normal mains supply fluctuations. Feed or alarm circuits include one pair of "normally open" and one pair of "normally closed" contacts, isolated from each other and from internal power supplies, and rated for non-inductive watts at 5 amp, 230-V, or 1 amp, 440-V 50/60 c/s a.c. Operation is on 200/250-V, or 110-V, 50/60 c/s single-phase supplies, and the unit imposes a load of 30-VA approximately. The control unit measures only 7⅞-in. × 7¼-in. × 4-in. with a choice of either back or base mounting. All units are fully weather-proofed with synthetic rubber gaskets between metal surfaces for sealing. (*Lancashire Dynamo Electronic Products Ltd., Rugeley, Staffs.*)

Smoke Alarm Equipment

Two new items of smoke alarm equipment are now available from Londex Ltd.—the smoke alarm unit, type-SAU, which provides a warning of excess smoke by means of indicator lamps and single-pole changeover output contacts; and the smoke density equipment, type SD, which indicates on a meter the degree of density, and is provided with output contacts, adjustable to preset limits. A recorder can be connected to this latter equipment, if desired. With the smoke alarm unit type SAU, a projector throws a parallel light beam across the flue onto a receiver head. Obscuration of the light beam by smoke causes the current of the photo-electric cell to vary according to the density of the smoke. When a predetermined smoke density has been reached, the relay in a control unit operates the output contact and also extinguishes a green lamp and illuminates a red lamp mounted in the control unit. In addition a small lamp fitted to the receiver head is illuminated; this being provided to facilitate initial setting up of the equipment. The receiver head also incorporates an adjustable iris to compensate for various flue diameters. A switch in the control unit allows

periodical checking to ensure that the alarm circuit is operating at the required smoke density. The projector and receiver heads are designed

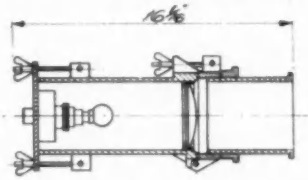
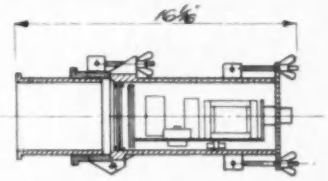


Fig. 8. Diagrammatic arrangement of Londex smoke alarm projector and receiver units. (Londex Ltd.)

to facilitate ease of installation and maintenance. The complete assemblies can be swung away for cleaning by releasing a thumb screw. Negative pressure should exist in the chimney at the position where the photo cell and projector heads are installed. This is to ensure that air is drawn over the lenses into the chimney, keeping them clean. If the heads cannot be mounted at a position where negative pressure exists in the chimney, it would be necessary for a compressed-air supply to be made available on site. The compressed-air would be connected to pressure entries on the photo-electric cell and projector head, thus ensuring that air is blown over the lenses to keep them clean. The operating principle of the type-SD equipment is similar to that of the smoke alarm unit. Obscuration of the light beam causes the current to the photo-electric cell to vary according to the density of the smoke; this is indicated on a meter in the control unit in percentage obscuration, as recommended. One meter is provided to give a continuous indication over the full scale of obscuration; a second meter is provided solely as a means of operating maximum and minimum level contacts. The contacts on this latter meter can be set at will to the required densities. Signalling lamps are fitted to the unit and these are illuminated when either high- or low-limit is reached. (*Londex Limited, 207, Anerley Road, London, S.E.*20.)

Automatic blow-down valve

The Carron Company have sent us details of a new automatic, self-clearing blow-down valve, known as the Carron-Smith valve. The main advantage claimed for this new unit is that in operation its function is dependent upon the supply and pressure of feedwater to the boiler. There is, therefore, a definite relationship between the amount of water blown-down from the boiler, and the amount of feedwater being introduced to the boiler with its associated scale-forming or other salts. The blow-down orifice discs incorporated in the valves control the amount of water blown down.



These are easily interchangeable and available in sizes to suit the individual plant requirements—the size being governed by various steaming factors such as hardness of raw water, percentage of condensate return, etc. The normal sizes supplied are 3/64-in., 1/16-in., and 5/64-in. The valve, which conforms to Lloyd's Register design requirements, has the body manufactured in phosphor bronze, PB3, and all internal working parts of either monel metal or stainless-steel. The prototype of the new valve was tested over a period of twelve months when fitted to a Lancashire boiler installed at a colliery, and using as boiler feed, pit water with a total hardness of 55 g.p.g. as $CaCO_3$, 47 g.p.g. being calcium sulphate. The water also contained a percentage of iron and had a high suspended solids content. No provision was made for condensate

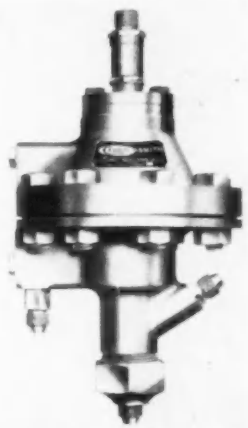


Fig. 9. The Carron-Smith automatic self-clearing blow-down valve, the operation of which is dependent upon the supply and pressure of the feedwater. (Carron Company.)

return, and the raw feedwater was treated with an internal chemical treatment which resulted in the formation of abnormal quantities of sludge in the boiler. Under these rather severe conditions the company claim to have been able to maintain a total dissolved solids content of the boiler water of between 5,000 and 6,000 p.p.m. (*Carron Company, Engineering Department, Carron, Falkirk, Stirlingshire.*)

Indicating temperature controller

A new indicating temperature controller introduced by The British Rototherm Co. Ltd. comprises a mercury-in-steel actuated 4-in. dial thermometer with a control unit having a single temperature operated pointer, and one or two adjustable pointers which can be set to " make " and/or " break." Standard energising

Fig. 10. The new Rototherm indicating temperature controller. (The British Rototherm Co. Ltd.)

coils operate on 100 to 400-V, 50 c/s a.c. supply. A feature of the unit is the mercury relay-switch incorporated, with contact loadings of 30-amps, 240-V a.c. for single-pole and 5 or 15-amps up to 440-V a.c. for 1, 2 or 3-pole. Minimum differential is ± 0.5 per cent. of the scale range. Switch contacts can be set normally open, normally closed or changeover. Any temperature range from − 20 deg. F. to + 1,000 deg. F., with minimum coverage of 50 deg. F. can be provided. The standard bulb is mild-steel, ½-in. diam., with copper sheathed capillary; other materials and separable pockets being available. The unit's black stove-enamelled case is provided with an indicator lamp, and electric conduit entry. (*The British Rototherm Co. Ltd., Merton Abbey, London, S.W.*19.)

Pneumatic bench vice

A safety cover, totally enclosing the distance travelled by the moving jaw of their pneumatic bench vice, has been incorporated by the Consolidated Pneumatic Tool Co., in the latest version of this unit. The company claim that substantial savings of time and labour can be achieved

by the use of this tool in operations where many changes of working position are necessary, requiring frequent operation of the vice jaws. These savings are effected by the simple air control provided which opens or closes the jaws in a fraction of the time taken by manually-operated vices. Particular applications are those of fettling and polishing, component assembly and many forms of repair work. The vice incorporates a 4-in. dia. air cylinder which provides 1,000 lb. pressure when operating on an 80 lb./sq. in. line pressure. The stroke of the piston and the moving jaw which it actuates is 1-in., whilst the rear vice jaw is adjustable by means of a locating nut to allow work from $\frac{1}{16}$-in. to 5-in. size to be accommodated. Jaw size is $3\frac{3}{4}$-in. by $4\frac{1}{2}$-in. The unit is housed in a cast-iron base, the jaws being of machined steel. The design allows for air control by a double-acting hand valve, although a foot control may also be supplied. (*Consolidated Pneumatic Tool Co. Ltd.*, 232, *Dawes Road, London, S.W.6.*)

Revised British Standard :
(B.S. 1633 : 1958)

The revised publication deals with the plates, sections, bars, rivet bars, and rivets used in the construction of land boilers, receivers and other pressure-vessels. A re-arrangement of contents (into two sections—for general and specific requirements respectively makes for simpler and quicker interpretation of the requirements for the six grades of material. Among the subjects dealt with under the "General" section are : manufacturing margins, marking, testing. Another section deals principally with chemical composition, heat treatment and mechanical properties of the steel. An interesting feature of the publication is an appendix which gives the ratio of the 0.2 per cent. proof stress at elevated temperatures to the minimum specified tensile strength at room temperature. Further appendices include the metric equivalents of the rolling margins for plates, and details of the tensile test pieces extracted from B.S. 18 (tensile testing of metals). Copies of this standard may be obtained from the **British Standards Institution,** Sales Branch, 2, Park Street, London, W.1. Price 6s.

* * *

A range of oil-fired packaged boilers is now being made by the **Farrar Boiler Works Limited,** Newark-on-Trent, Notts, with steaming capacities ranging from 5,000 to 11,000 lb. hr. As hot-water units, they are capable of outputs of from 5 million to 11 million B.Th.U./hr. Smaller units are under development. The "Farrapac" boilers are of the triple gas-pass type, with thermal efficiencies of around 80 per cent. The standard oil-burners fitted can handle oils up to 3,500 sec. Redwood No. 1. In particular, it is claimed that the interior of this type of boiler can be easily inspected, and that the tubes can be removed without disturbing the brickwork. Forced or induced-draught units can be provided as required.

* * *

English Steel Corporation Ltd. announce that **Mr. W. E. A. Redfearn** has been appointed a director. He has been associated with English Steel Corporation Ltd. and its predecessors since 1915, and is deputy managing director of English Steel Forge and Engineering Corporation Ltd., and a director of English Steel Rolling Mills Corporation Ltd. Mr. Redfearn has been chairman of the Alloy Steel Association for a number of years and, as deputy chairman of the Alloy & Stainless Steels Conference, is a member of the Council of the British Iron and Steel Federation and numerous committees of the Federation.

Lancashire Dynamo Nevelin Ltd., Oxted, Surrey (a member of the Lancashire Dynamo Group), announce the introduction of an entirely new range of a.c. motor control gear. For direct-on starters up to 60 h.p. and star-delta starters up to 100-h.p. a unique design of vertical lift-block-type contactor is employed in conjunction with a wide range of ambient temperature compensated thermal overload units. A special feature of the design is the ease with which contacts can be inspected, the complete unit being dismantled by removing only two screws. Silver to silver double contacts per phase are provided and auxiliary contacts can be fitted as required. Full details of these starters are given in leaflet LS.2700, which is available on application.

* * *

Combustion Chemicals Limited, which was recently formed, claim to offer a specialised service to users of virtually every type of liquid fuel, particularly those operating hot water and central heating boilers, steam-raising and process plant burning residual fuel oil, compression engines burning diesel gas oil or residual fuel oil and spark ignition engines burning petrol. The combustion chemical range of liquid fuel improvers, including Desulfurol, Dieselfur and Dieseladd, is, it is believed, the only range of liquid fuel additives capable of counteracting the effects of the sulphur content of liquid fuels. Considerable success has been achieved in the reduction of sulphate scale, sulphur corrosion and acidic stack emission and in the elimination of sulphur fumes. Combustion Chemicals Limited back this range of products with the services of combustion engineers with considerable experience in boiler-plant, and diesel engine operation.

* * *

The latest publication (Folder 5805) from **Hopkinsons Ltd.** describes the company's water-level television equipment. The equipment is arranged for use with a prismatic water-level indicator, of either the plate or "Bull's-eye" type, in conjunction with an illuminator fitted to the water-gauge. Light from the illuminator passes through the prismatic indicator in such a way that the steam space appears as intense clear light and the water column as dull diffused light.

* * *

Mr. R. H. Mardell has been appointed London Area sales manager for General Refractories Ltd., in succession to **Mr. T. S. Aikman,** who has recently retired. Mr. Mardell has been assisting Mr. Aikman for several years as London Area sales representative.

A demonstration of the first installation in this country of the Redfyre Emma coke-fired boiler took place at the Belgrave Gate Stores of the East Midlands Gas Board, Leicester, recently, when some two-hundred people were the guests of the Gas Board and of **Newton Chambers Ltd.,** who manufacture and install the boiler in the United Kingdom, under an agreement with Bronswerk N.V., of Holland. A reference was made to the Redfyre Emma in the June, 1958, issue of this journal, when it was pointed out that units of this type are used extensively on the Continent in connection with central heating and hotwater supplies. Such installations have ranged from a single unit of 250,000 B.Th.U. hr. capacity to multiple installations of, for example, four units providing a total output of 30-million B.Th.U. hr. Visitors to the demonstration at Leicester were, in fact, informed of an installation to be completed in this country—at Loughborough College—which will comprise five units, with a total capacity of 34-million B.Th.U. hr. A special feature of the boiler is that it incorporates a secondary combustion chamber, and is, in effect, a gas-producer as well as a boiler. This, it is claimed, ensures an efficiency of between 85-90 per cent., with a resultant saving in fuel. The "Emma" will burn all types of coke, in sizes from $\frac{3}{4}$-in. to 4-in. and it can be used with various types of coke-handling equipment, or charged manually. Automatic temperature control is provided.

* * *

Additions to the Aerofoil fan range are covered in a new edition of the **Woods of Colchester Ltd.** catalogue V1089. A 60-in. size has been introduced, and 12-in. fans are included in the adjustable pitch impeller series, eight diameters being now available. Higher speeds with power outputs up to 50-h.p. per stage are offered in the larger sizes. New ancillary equipment included is an attachable guide vane unit giving up to 15 per cent. higher pressure without increase in horse power. Woods' silencers have been redesigned to permit hot-dip galvanised finish and lower prices. As an alternative to the Aerofoil "Maxcess" retractable casing, fittings are offered which enable standard fans to be swung out from the operating position for clearing. The new catalogue is in two sections. Descriptions and illustrations are contained in one part (reference V1089), and fan selection tables, dimensions and weights are in a separate section (V1089T). Copies of the catalogue can be obtained from Woods of Colchester Ltd., Braiswick Works, Colchester.

OVERSEAS Steam Engineering Practice

Abridgments of recent articles in the colonial and foreign technical press, concerning design and progress in the technique of steam generation and power plant equipment

New method of scale-removal

The boiler plant at the Cleveland District No. 1 power station of the Republic Steel Co. of America comprises three Babcock & Wilcox two-drum Stirling-type boilers, each rated at 220,000 lb./hr., at 900 lb./sq. in. and 850 deg. F. These units can be fired by any combination of blast-furnace gas, coke-oven gas, and/or pulverised-coal. Since, in the event of a boiler being out of commission, steel production must be curtailed, the company are continually searching for new and more efficient methods of cleaning their boilers. It is stated that a major advance has been made by the use of a method of chemical cleaning, employing a chelating agent. The first occasion on which this system was used was in December, 1955, when the application comprised Versene 100, a water solution of ethylenediaminetetraacetic, tetrasodium salt (Na_4EDTA), a product of the Dow Chemical Co. The actual procedure followed was to introduce sufficient chelating agent into the boiler, after the pressure had been reduced to 150 lb./sq. in., to result in a 1.2 per cent. solution of Na_4EDTA. Intermittent boiling was continued at approximately this pressure, until the reaction of the Versene with the scale components was apparently complete. In this instance, the pH was maintained at 10 or above, by the periodic addition of caustic soda. Approximately 18 hours was required for the operation. A study of the economics involved in the use of cleaning with chelating agents compared with the cost of normal methods indicated a saving of 65 per cent. In December 1956, the boiler was again taken off load, and upon inspection the mud-drum, steam-drum and visible tubes revealed about one-half the quantity of sludge compared with that found on previous occasions. Apatite sludge in the drums was not of the usual tenacious variety, and much of it was "flushed out" by hosing down. After flushing, there remained between 1/32 to 1/16-in. sludge on the drum surfaces, with a somewhat heavier deposit in the tubes. At this time, the boiler was given its second cleaning by the chemical method. For this trial, an original pH of between 7.5 and 8.0 was used, which rose gradually as the reaction proceeded. Chelating agent solutions with a pH of approximately 7.8 were made up in 100-gal. batches, using Versene Acid, an ethylenediaminetetraacetic acid (H_4EDTA) to neutralise the water solution of Na_4EDTA. The resulting mixture was pumped through the chemical feed lines to the boiler system. For this second trial, the boiler was filled with 18,000 gal. of condensate at a pH of 7.1 The first application used four drums of Versene 100 and 300-lb. of Versene Acid. This resulted in a concentration of 0.68 per cent. of Na_4EDTA. Later in the trial a further addition of one drum of Versene 100 and 50-lb. of Versene Acid was made to give a total of 0.91 per cent. Na_4EDTA. Periodic titrations were made for available chelating agent, and pH and phosphate concentration. Comparing the results of the 1956 cleaning with those of the previous year, when the high-alkaline conditions were used, it was apparent that the chelating agent-apatite reaction proceeded at a greater rate, and went further towards completion. Although there was a residual of unreacted chelating agent in the system, it was less than that experienced in the previous trial. One important advantage of this method of cleaning became apparent during these experiments, namely, that when the chelating agents were introduced into the steam drum, the natural circulation, which was brought about as a result of the periodic firing of the boiler, carried the highest concentration through the down-comers and the mud-drum in exactly the pattern where the greatest amount of cleaning was needed. This assured maximum effectiveness. The use of condensate in the second test was purely experimental, and as no particular benefit was observed, in future the boiler pressure will merely be reduced to 150 lb./sq. in., as in the first test. Visual inspection following the second application of Versene showed the tubes to be between 80 and 90 per cent. clean. Assuming a delayed action as on the first chemical application, it can be assumed that more sludge was cleaned off after the boiler was put back into operation. (*Power Engineering*, Vol. 62, No. 11, pp. 61/63.)

Solving duct design problems

A "water table" test procedure for studying the effects of inlet and outlet duct arrangements upon air-flow patterns within electrostatic precipitators has been devised by the Buell Engineering Co. Inc., of America. The efficiency of dust-collectors is affected by the distribution and smoothness of the gas flow through the collector, and hence it is desirable to design ductwork, vanes and baffles for uniform distribution and minimum turbulence. Each installation is different in that ducts leading to and from the collector are designed to meet particular space situations, and seldom are any two alike. Before adapting the water table to general use, tests were conducted correlating water-flow patterns with air-flow patterns obtained in an actual duct. The results obtained were sufficiently close to indicate that the watertable data were reliable. Subsequent site results have verified this contention. The water table consists of a 3-ft. × 5-ft. × 5-in. deep table with a water inlet at one end and an outlet at the other. Discharged water is collected in a tank located under the table, and is recirculated by means of a ¾-in. h.p. pump. Velocity is controlled by a valve in the 1-in. inlet pipe and this valve is generally fully open. Changes in velocity do not greatly affect the flow pattern but sometimes it is desirable to study the pattern in "slow motion." Strips of metal, 2 to 3-in. high, are arranged on the table, on edge, to form a cross-section of the precipitator, to scale of about ½ or 1-in. to the foot. The cross-section generally represents a vertical plane parallel to the flow through the precipitator. Horizontal distribution is generally sufficiently uniform, but vertical flow can extend into the collector hoppers, set up eddy currents, and travel in strata at

different speeds. It appears that by trial and error, laboratory personnel have devised ways of observing the flow of water. The best method found to date is to dye the water blue with ordinary bluing, and then sprinkle it at the inlet with aluminium powder. This creates an effective pattern indicating flow characteristics. To extend the knowledge gained in the laboratory, and to make this information available to precipitator users, motion pictures are taken of the various arrangements tried in solving a particular problem. Also, time exposures are taken to indicate the results of various arrangements. This technique had been found to be considerably more economical than trial and error tests on site or even three-dimensional laboratory tests. (*Combustion*, Vol. 30, No. 5, p. 56.)

Rubber-lined pipe for ash-handling

Maintenance of pipe-lines in ash disposal systems has for a long time been a problem in coal-fired boilers in power plant installations. Rubber-lined pipes, however, can, it appears, provide one answer. Bends in such pipe-lines are handled by (a) standard fittings lined with rubber; (b) flexible pipe; or (c) special fittings incorporating re-placeable wear sections. Various joints are available, the majority being based on a standard flange connection. All types, however, share the advantages of resistance to corrosion and erosion, easier installation and maintenance. A cast-iron ash-disposal pipe-line, some 300-ft. in length at the New Haven Railroad Co., Cos Cob power station was quickly worn away and holed by the abrasive action of the ash and, in order to forestall this trouble, the pipe was rotated one-eighth of a complete turn every three months. Only a few sections could be turned at a time, and the whole undertaking took some five days. Steel pipes, lined with ¼-in.-thick rubber compound, specially developed for ash-handling systems, were used to replace the cast-iron pipes, and records show that these served for nearly three years without turning. Even then, the light weight of the steel pipes, permitted some 200-ft. to be rotated at one time, the whole job being completed in a day. At that time, the pipe was turned 180°, giving a life of between two and three times that for cast-iron pipe. (*Power*, Vol. 102, No. 11, pp. 116-117.)

Mr. Arnold Carr, assistant managing director of Thos. W. Ward Ltd., Albion Works, Sheffield, has been appointed deputy chairman of the company. Mr. Carr was appointed local director in 1936, and was elected a director in 1941, becoming resident London director during that year. He returned to head office as assistant managing director in January, 1954. Mr. Carr is also chairman and director of a number of companies of the Ward Group at home and abroad. **Mr. Douglas F. Walton** has been appointed a director of Thos. W. Ward Ltd. Mr. Walton became a local director of the company in 1940. He is also a director of the Ketton Portland Cement Co. Ltd., Darlington Railway Plant & Foundry Co. Ltd., and Railway & General Engineering Co. Ltd.

* * *

Alldays & Onions Ltd., Great Western Works, Sydenham Road, Birmingham, 11, announce that **Mr. R. E. Gardiner** has been appointed London manager, in succession to Mr. R. J. Nash.

* * *

Second in the new series of 'Caposite' amosite asbestos technical data sheets on heat insulation issued by the manufacturers, **The Cape Asbestos Co. Ltd.,** is devoted to internal and external flat surfaces (ref. No. 281057/2). Diagrams show a preformed specification for the insulation of ducting with "Caposite" blocks protected with "Caposil" hard-setting cement, reinforced with 1½-in. mesh galvanised wire netting and waterproofed with "Capoplastic" waterproofing compound. A table showing thermal conductivity of "Caposite" blocks gives a figure of 0.61 B.Th.U. sq. ft. hr. deg. F. for a hot face temperature of 1,000 deg. F. (mean temperature 550 deg. F.).

* * *

Londex Ltd., Anerley Works, 207, Anerley Road, London, S.E.20, have published a new 44-page Data Book, which includes, together with details of most of their well-known products, information relating to a number of new items, such as the 'SM' series of miniature relays, smoke alarm equipment and a photo-electric transistor unit.

The following appointments are announced in the A.E.I. Turbine-Generator Division: **Mr. J. Richmond** as divisional executive (Rugby) and sales manager (Rugby), in succession to Mr. J. G. Boddy, who relinquished these positions in order to take up another appointment; **Mr. J. W. Ward** as assistant sales manager (Rugby); **Mr. D. R. S. Turner,** formerly manager (Larne Works), as divisional commercial manager, taking over the duties previously performed in that capacity by Mr. R. J. Cochran, who is devoting full time to his position as divisional general manager. **Mr. R. R. Whyte,** hitherto divisional manufacturing manager (Trafford Park), is now divisional manufacturing manager, retaining his existing appointment as assistant works manager (Mechanical, Trafford Park), while **Mr. W. T. H. Golding** is now works manager (Larne Works). **Mr. R. O. Knight** has been appointed superintendent, Larne Works. Other appointments not hitherto recorded include **Mr. H. I. Wood,** chief engineer, turbo-generator department, Trafford Park; **Mr. F. R. Harris,** chief engineer, gas turbine engineering department; **Mr. F. W. Craven,** superintendent, small turbine department; and **Mr. J. B. P. Wood,** assistant superintendent, small turbine department. All these departments form part of the A.E.I. Turbine-Generator Division.

* * *

That interest is growing in the work of the **National Industrial Fuel Efficiency Service** is shown by the fact that since April, 306 heat and power surveys have been completed as compared with 244 for the corresponding period last year. The number of bookings made in October was 57 against 38 last year, an increase of 50 per cent. But it is in the sphere of regular service agreements that the growth is most important because here a long term association is foreshadowed with all the advantages of continuity of advisory and general services. The number of regular service agreements is stated to have risen from 490 a year ago, to no less than 618 at the present time.

A notable advance in the field of polymer chemistry is claimed to have been achieved by a research team working in the central research laboratories of **Albright & Wilson (Mfg.) Ltd.,** on a research project into the nature and properties of Phosphonitrilic Chlorides. The company say that as a result of the success of the initial stages of this work it is now practicable to separate the trimer and the tetramer from the crude mixture of cyclic and linear polymers, and they are the first chemical manufacturing company in the world to announce that they can separate the polymers on a commercial scale. Phosphonitrilic compounds have several similarities to silicones, and Albright & Wilson, Ltd., are hopeful that a wide range of heat-resistant materials, in addition to other products, will be developed from them. A booklet dealing with phosphonitrilic chloride polymers (a German version is also available) can be obtained from the Organic Chemical Department of the company at 1, Knightsbridge Green, London, S.W.1.

* * *

Recent appointments made by Metropolitan-Vickers Electrical Co. Ltd., include those of **Mr. E. W. Stainton,** B.Sc., A.C.G.I., A.M.I.E.E., as assistant sales manager, switchgear department; **Mr. D. R. Clegg,** Grad.I.E.E., Assoc. Mem. A.M.E.M.E., as assistant sales manager, transformer department; Mr. F. H. Davis, M.Sc.(Met.), assistant superintendent, foundries; **Mr. D. E. Thornhill,** B.Sc.(Tech.), assistant superintendent, transformer department, Wythenshawe.

* * *

We have received from **Sigmund Pumps Ltd.,** Team Valley, Gateshead, 11, a new publication (No. D145) which sets out in pictorial form the full range of pumps available, and the extent of the contracts undertaken by the company. Details of the very wide range of pumps manufactured by the company, and which find applications in almost every industry, are contained in separate publications which are listed in the new brochure.

Latest Power Plant Patents

These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Steam generator with divided furnace

In pulverised-fuel-fired boilers for high-pressure and temperature operation it is desirable to establish a long flame path when a fuel of low volatile content is to be used. In the boiler shown in outline in Figs. 1 and 2 the combustion chamber (1) is fired through front wall (3) and rear wall (5) by respective groups of low volatile, pulverised-fuel burners (37 and 39) of the non-turbulent

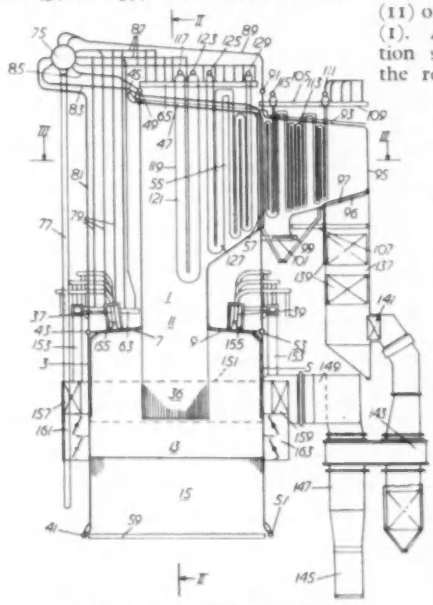


Fig. 1 (left). British Patent No. 802,173.

Fig. 2 (below). British Patent No. 802,173.

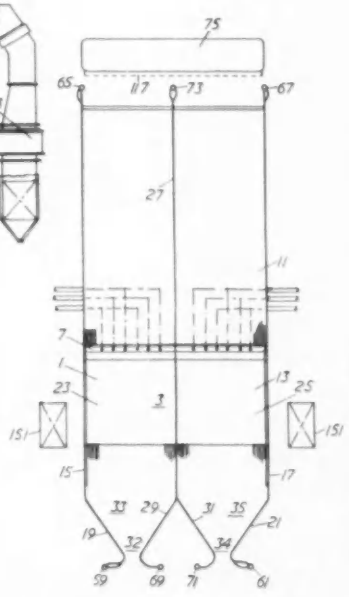
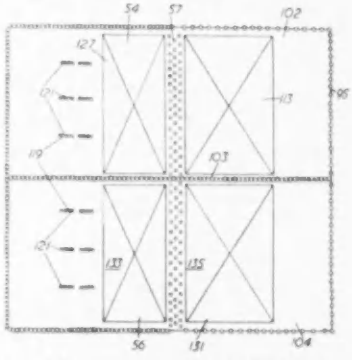


Fig. 3 (right). British Patent No. 802,173.

type, which are arranged to discharge downwardly into the combustion chamber (1) from the lower faces of the arches (7 and 9). The combustion chamber (1) with partition wall (27) is cooled by steam-generating wall-tubes; the tubes lining a lower part of the front wall (3) extend upwards from a lower header (41) to a header (43) at the level of the arch (7). From the header (43) steam-generating tubes extend rearwards along the arch (7), and thence vertically upwards along an upper part of the wall (3). Alternate tubes are bent at their upper ends out of the plane of the wall, and are connected to a header (45), whilst the remaining tubes extend vertically through the roof (47) of the boiler to a header (49). The steam-generating tubes lining the rear wall (5) of the chamber (1) extend upwards from a lower header (51) to an intermediate header (53) at the level of the arch (9). From the header (53), some tubes extend forwards to line the arch (9), and thence vertically upwards to form the rear wall (5) of the upper part or radiation section (11) of reduced depth of the chamber (1). At the upper end of the radiation section (11), the tubes lining the rear wall (5) extend rearwards and upwards from the upper end of the chamber (1). Steam passes from the superheater inlet header (11) into a pendant sinuous tube-type primary superheater (113) located in the gas flow path extension (102) of the gas-pass section (54) rearwards of the tube screen (57). Outlet header (115) of the primary superheater (113) connects with an inlet header (117) of a pendant radiant superheater (119) comprising tube platens (121). These are relatively widely spaced across the width of the combustion chamber (1) at its upper end and located immediately in from the lateral pass (55). From the outlet header (123) of the radiant section, superheated steam is conducted by way of an attemperator (not shown) to an inlet header (125) of a pendant, sinuous tube type of



secondary superheater (127) placed in the gas-pass section (54) (Fig. 3) between the tube screen (57) and the radiant superheater (119). From the outlet header (129) of the secondary superheater, the steam is conducted to the turbine. A pendant sinuous tube type reheater (113) is provided, and comprises sections (133 and 135) of which the section (133) is placed in the gas-pass section (56) between the radiant superheater (119) and the tube screen (57), whilst the section (135) is placed in the gas-flow path extension (104) rearwards of the tube screen (57). The lateral pass (55) serves to connect the upper part of the combustion chamber (1) with a downpass (137) by way respectively of passages (54, 102) and (56, 104) which includes economiser surfaces (139). The pass (137) is vertically divided throughout its height by a metallic baffle (not shown) placed in the plane of the partition wall extension (103) so as to divide the downpass (137) into sections

respectively communicating with the gas-flow path extensions (102 and 104). Downstream in the sense of gas-flow from the economiser (139) are placed groups of dampers, such as the damper (141), for controlling the gas-flows respectively, through a path comprising the combustion chamber section (23), the gas-pass section (54), the gas-flow path extension (102) and the section of the downpass (137) connecting with the gas-flow path extension (102) and a path comprising the combustion chamber section (25), the gas-pass section (56), the gas-flow path extension (104) and the section of the downpass (137) connecting with the gas-flow path extension (104). *British Patent No.* 802,173 *issued to Babcock & Wilcox Ltd. Complete specification published October* 1st, 1958.

Boiler with steam temperature booster

With an installation comprising a boiler which provides steam at a temperature of the order of 900 deg. F. for driving a turbo-alternator, practically the whole of the steam generated by the boiler is utilised in the turbo-alternator, and the latter does not receive steam from any other boiler. If, for example, in such an installation by reason of an electrical fault the alternator is caused to trip out, the machine is then shut down and the boiler will also require to be shut down. As soon as the electrical fault is cleared, it is desired to restore the load on to the turbo-alternator, but if the electrical fault has been cleared in a short space of time, the turbine is still standing at a temperature approximately of 900 deg. F. As the steam, which will be first produced when re-starting the boiler, may be at a comparatively low temperature, say 650 deg. F., the steam cannot be passed directly to the turbine, as a sudden inrush of cool steam on to the hot turbine blades would be detrimental. It is, therefore, advantageous to provide means for boosting the temperature of the steam to the turbine. It is one object of this invention to provide means of applying the additional heat required to the existing superheater at a temperature acceptable to the superheater without overheating of the superheater tubes and without exposing them to direct radiation. Fig. 4 shows diagrammatically, and partly in vertical section, a natural-circulation water-tube boiler incorporating a burner of the type shown in Fig. 5 for superheat boosting. In operation oil under pressure is atomised at the nozzle (1) of the burner, Fig. 5, and is mixed with combustion-air in the combustion-chamber (2) where it is burnt with a flame indicated at (15). The outer extremity (16) of the flame (15) generally has a temperature of about 3,000 deg. F., and a stream of hot gas flows outwardly from the combustion chamber (2) along the extension (9) of the combustion chamber (2). A supply of attempering air, or other non-combustible gas, is pumped into the casing (12) to pass through the apertures (11) and mix with the stream, so that when the mixture reaches the outlet (10), its temperature is reduced to the order of about 1,000 deg. F. Fig. 4 illustrates an application of the invention to a natural-circulation water-tube boiler. The boiler has a combustion chamber (17) surrounded by water walls (18) within a heat-insulated casing (19). A steam and water drum (20) is located above the combustion chamber and is connected to the upper ends of banks of steam generating tubes indicated at (21) the lower ends of which are connected to lower headers such as (22). The banks (21) of the steam generating tubes are located across an outlet (23) to the combustion chamber (17) and combustion gases pass through this outlet and over banks of superheater tubes (24), before being exhausted from the boiler. A series of burners of the form shown in Fig. 5, and one of which is indicated at (26), are located externally of the boiler and are arranged to supply heated non-luminous gases directly to the superheater tubes (24). These gases are piped from the outlet of each burner through a conduit (27) to discharge nozzles indicated at (28), located immediately above the superheater tubes (24). If the main boiler fires in the combustion chamber (17) are shut down, by reason of the occurrence of an electrical fault in a turbo-alternator supplied with steam from the boiler, when the electrical fault is cleared the burner (26) is ignited to superheat the steam so that the boiler may resume operation quickly. If desired the combustion chamber (15) of the burner (26) may be water-cooled, or may be cooled by part of the attempering air or gas pumped into the casing (12). As shown in Fig. 4, the attempering air or gas is drawn from the flue casing (25) through a conduit (29). *British Patent No.* 803,548 *issued to John Thompson Water Tube Boilers Ltd. Complete specification published October* 29th, 1958.

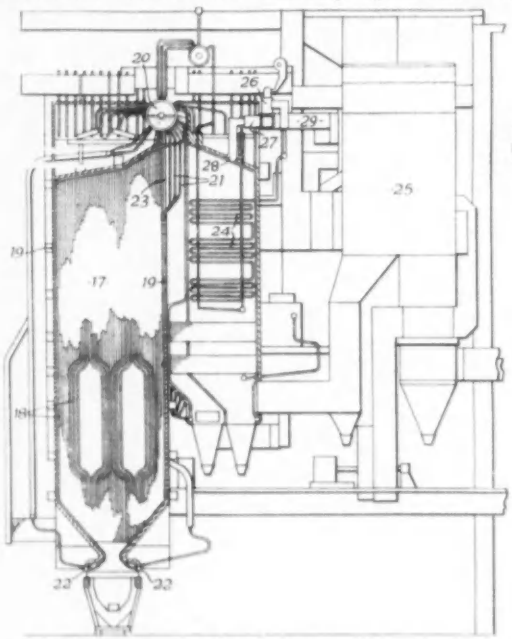


Fig. 4 (left). British Patent No. 803,548.

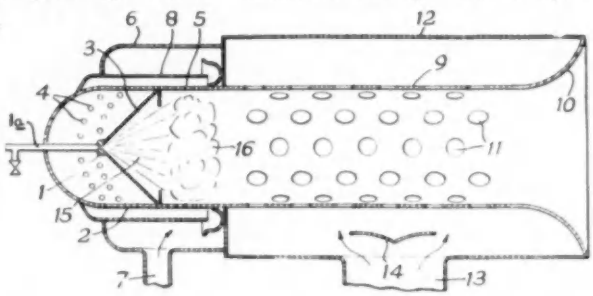


Fig. 5 (above). British Patent No. 803,548.

Heat exchanger tubing

This invention relates to tubular heat-exchangers in which one fluid passes through the tube so that heat transfer takes place from one fluid to the other through the wall of the tube. If the tubes of such heat-exchangers should leak, the fluids would mix, and it is an object of the invention to provide a tube for heat-exchangers in which the possibility of fluid leaking from within the tube to outside the tube, or vice versa, is substantially reduced or eliminated. In Figs. 6 and 7 the composite tube (1) proposed for this purpose comprises an inner tubular member (2) and a wall in the form of a strip or wire (3), of heat-conducting material such as copper, helically wound around the member (2) with the convolutions of the strip spaced apart. This member, with the surrounding strip, is contained concentrically within an outer tubular member (4) of such internal diameter that there is a fit between the internal surface of the outer member and the outer surface of the strip. Thus, a continuous helical passage (5) is formed between the inner and outer members which extends between, and communicates with each end of the tubes. These tubes are built into a heat-exchanger in which one fluid is passed through the inner tube (2) and another fluid at a different temperature is passed over the outer tube (4). A source of inert gas is connected to the helical passage (5) between the inner and outer tubes. The inert gas is at a different pressure from the pressure of either fluid so that if by any chance there is leakage in one of the tubes, fluid will pass into or out of the helical passage between the tubes depending upon the pressure difference, and the pressure within the passage between the tubes will then be changed. This change of pressure can be detected by a pressure-measuring instrument such as a pressure gauge (6) connected to the passage (5) by a pipe (7). Such a change of pressure indicates that a leak has occurred. As indicated in Fig. 8, the composite tubes in the heat-exchanger are connected between headers (8), one having an inlet (9) for one fluid and the other an outlet (10). The other fluid passes by an inlet (11) into the casing of the heat-exchanger where it passes over the outside of the tubes and thence to an outlet (12). The passages (5) between the inner and outer tubes are connected by a common outlet pipe (13) to a gauge which will indicate the pressure in the passages (5). In operation the pressure of the inert gas in the passages (5) is different from the operating pressure of the fluid in the inner tubes (2) and over the outer tubes (4). Hence if there should be leakage from either tube (2) or (4) into the passage (5), it will be indicated by a change of pressure in the passage (5). In an alternative arrangement the passage (5) is connected to a container having a chemical reagent which will give an indication of leakage, as for example by change of colour of the reagent. *British Patent No.* 804,592 *issued to John Thompson Water Tube Boilers Limited. Complete specification published November* 19*th*, 1958.

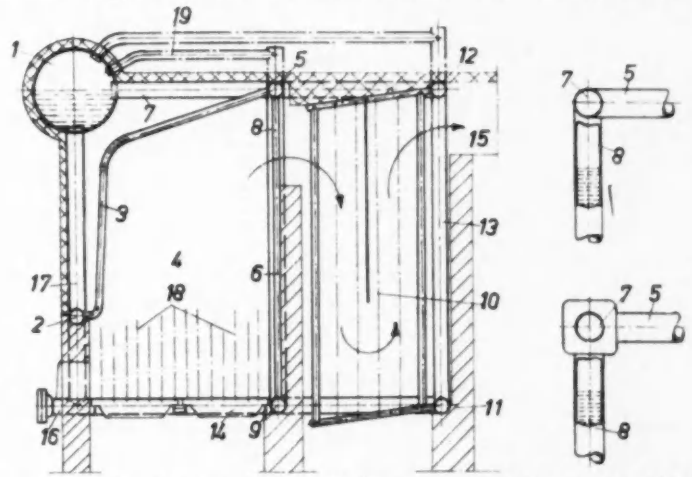


Fig. 9 (left). Fig. 10 (top, right). Fig. 11 (bottom, right). British Patent No. 805,067.

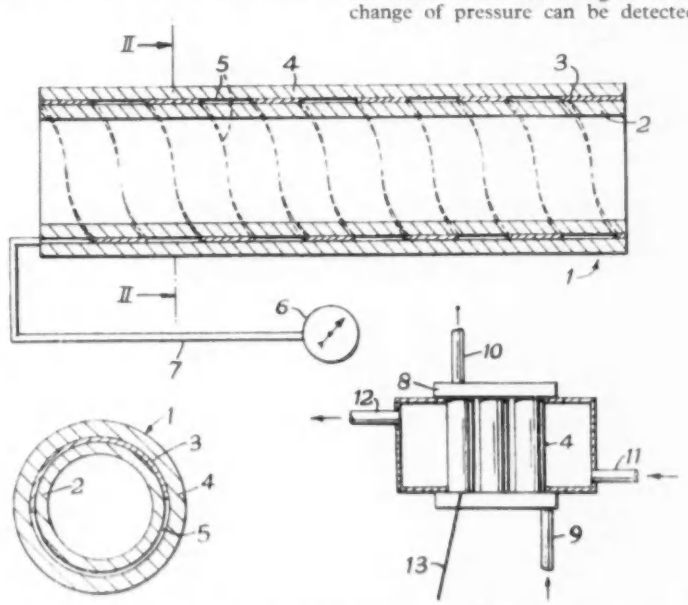


Fig. 6 (top). Fig. 7 (bottom, left). Fig. 8 (bottom, right). British Patent No. 804,592.

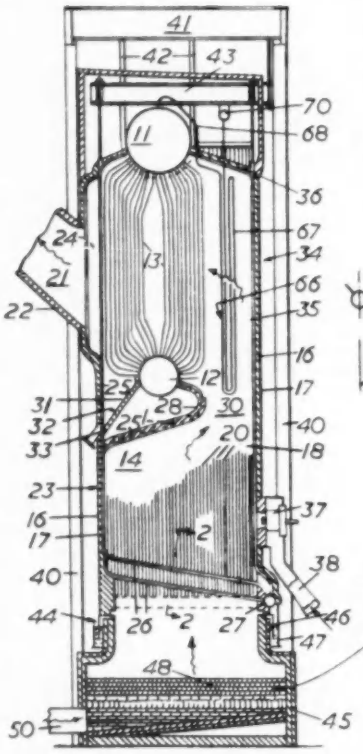
Steam boiler

This invention relates to steam generators having natural circulation, and is intended to improve the return flow of the boiler water. It is known *per se*, when water walls are situated in the furnace, to connect the upper collector headers by return tubes to lower distributor headers. In this case, however, the return flow of the boiler water is obstructed as a result of the fact that the mixture of steam and water emerging from the evaporating tubes does not have

sufficient time to separate. Fig. 9 shows a steam generator according to the invention. Beneath the drum (1) is situated a distributor header (2). The evaporator tubes (3) which line the front wall and roof of the furnace (4) emanate from the distributor header (2). The evaporator tubes (3) lead into the upper collector header (5). The back wall tubes (6) also lead from a lower distributor header (9) into the same collector header. The collector header (5) runs parallel to the drum (1) and lies with its axis approximately level with the normal water-level in the drum. From the ends of the collector header (5) horizontal connecting tubes (7) go to the drum, and return tubes (8) lead to the lower distributor header (9). The steam/water mixture generated in the evaporator tubes (3 and 6) flows into the collector header (5). In the header it is led horizontally to each end, so that it can partially separate on this path. The separated water flows directly through the return tubes (8) into the lower distributor header (9) and then to the evaporating system, by-passing the drum. The mixture, largely free of water, flows through tubes (7) to the drum (1). It is possible to arrange the contact heating surface in a gas-pass leading from the furnace in accordance with the same principle. As shown in Fig. 9, the contact heating surface (10) consists of a number of tube panels, which start from a lower distributor header (11) and lead into an upper collector header (12). Like the collector header (5), this collector header (12) is also connected by the same tubes (7) to the drum (1). The water separated in it flows back through the return tubes (13) to the lower distributor header (11). The gases rising from the grate (14) flow through the steam generator in the direction of the arrows and emerge through the opening (5). It is, of course, possible to utilise the heat of the gases leaving the steam generator in a preheater heating surface, which can be placed in a further gas pass. As shown in Fig. 9, the lower distributor headers (2, 9 and 11), and the collector headers (5 and 12) are parts of a tube frame to which also belong the upper horizontal tubes (7), the lower tubes (16) the return tubes (8 and 13), and the downcomers (17). The drum (1) and the heating surfaces of the steam generator are carried by this tube frame. A separate boiler frame is thus eliminated. Figs. 10 and 11 show the connection of the collector header (5) to the tubes (7 and 8). In Fig. 9 the tube (8) is widened to a larger diameter at the lead-in point in order to simplify the connection of the tubes. *British Patent No.* 805,067 *issued to H. Vorkauf. Complete specification published November 26th,* 1958.

Boiler for catalytic combustion

In the catalytic conversion of hydrocarbons in, for example, a fluidised-bed, the catalyst material loses its activity by being coated with carbonaceous materials during the reaction. The contact catalyst is reactivated by removing the coating in a separate regeneration zone, where the reactivation is accomplished by the introduction of air or other oxygen containing gases. This invention proposes a steam generator in which gases from a regeneration zone can be used for reactivating carbon coated catalyst. In Figs. 12, 13, 14, the steam generating unit is arranged for pressure firing. The unit is constructed and arranged to be used either as a steam generator fired by conventional fuel, or as a waste-heat steam generator supplied with gases heated by the catalytic conversion of carbon-containing gas, or both sources of hot gases can be used simultaneously. Referring to Fig. 12, it can be seen that the unit includes upper and lower drums (11 and 12) connected by rows of steam generating tubes (13) forming convection heating tube banks. The casing enclosing these banks is extended to provide a furnace (14), and the walls of the casing are lined with steam generating tubes. In the drawing, the fuel burner (37) is illustrated as being of the liquid fuel type, although gaseous fuels may also be used to provide the furnace (14) with high heat-content fuel. Combustion-air is supplied to the burner (37) from an outside source (not shown) through a duct (38) at super-atmospheric pressure. The refractory enclosure (45) is filled with a mass of oxy-catalyst elements (48) through which carbon-containing gases are passed for the conversion of the gas to carbon dioxide. The refractory enclosure is provided with a gas inlet duct (50) through which the hot carbon-containing gas from a hydrocarbon catalyst regeneration zone is passed. The oxy-catalyst elements (48) installed in the refractory enclosure (45) consist of a number of individual blocks arranged side by side in a number of rows so that the gases pass upwardly through them and the carbon-containing hot gases are converted to carbon dioxide with the generation of heat. The much hotter gases then pass through the tube rows (26) into the furnace (14). As shown in Fig. 14, each individual oxy-catalyst element (48) is formed as a number of closely spaced inert refractory tubes or rods (51) coated with an external catalytic film such as platinum or a mixture of platinum and aluminium oxide. The catalytic films are effective in converting carbon monoxide gas, at a temperature of the order of 750 deg. F. or above, into carbon dioxide at a temperature of from 1,450 to 1,750 deg. F., when



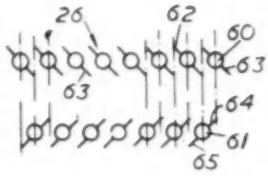


Fig. 12 (extreme left). *British Patent No.* 804,829.

Fig. 13 (*above*). *British Patent No.* 804,829.

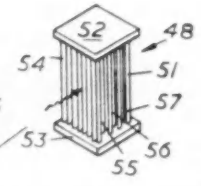


Fig. 14 (*left*). *British Patent No.* 804,829.

leaving the elements (48). While the oxy-catalyst elements (48) are extremely effective within the temperature ranges described, the elements will lose their catalytic effect if they are exposed to temperatures in excess of approximately 1,800 deg. F. In the arrangement described, the combustion of high heat content fuels, such as fuel-oil, in the furnace (14) creates temperatures considerably above the 1,800 deg. F. limit of the oxy-catalyst elements. Therefore, it is essential that the elements (48) be screened against the transmission of radiant heat from the high temperature flame created by fuel-oil combustion in the furnace (14). As shown in Fig. 12, the screening of the elements (48) is accomplished by the vertically spaced tube rows (26) in which the tubes of each row are spaced to provide a flow path for the gases moving upwardly from the oxy-catalyst elements (48). As shown in Fig. 13, each of the tubes (60) in the upper row is provided with a radial fin (62) which projects upwardly and extends longitudinally of the tube for the full width of the furnace (14). A similar, diametrically opposite fin (63) extends downwardly from each tube (60) and both fins are inclined with respect to the direction of gas flow through the screen so that the fins of adjacent tubes in the row prevent radiation in a vertical direction from the furnace (14). In operation, a unit of the type described was initially fired by fuel-oil and produced a steam output of 60,000 lb./hr. At a later date, gas from a catalyst regeneration zone was passed through the duct (50) to the oxy-catalyst elements (48) in an amount equal to 216,000 lb./hr., and at a temperature of 840 deg. F. The carbon monoxide in the gas was converted to carbon dioxide and the gas was passed into the furnace (14) at a temperature of approximately 1,750 deg. F. to produce 60,000 lb./hr. of steam without the addition of any high heat content fuel to the furnace (14). The gas from the hydrocarbon regenerator, while having a relatively high sensible heat, contained only about 20 B.Th.U./cub. ft. of gas from the combustibles in it. *British Patent No.* 804,829 *issued to Babcock & Wilcox Ltd. Complete specification published November 26th,* 1958.

Mr. H. S. Horsman, M.I.Mech.E., A.M.I.E.E., F.Inst.F., retired from the service of Central Electricity Generating Board on Dec. 31st. Following the First World War he was employed by Babcock and Wilcox for a period of 10 years, and in 1930, he joined the London Power Company Limited, and served 17 years in the Construction Department. On nationalisation of the electricity supply industry he was offered the post of efficiency and testing engineer, and he has held this up to the present time. Mr. Horsman is a gold medallist of Liverpool University in respect of engineering research. He is also the holder of the Princess Elizabeth silver medal of the R.S.A. for a paper on district heating. He has been an active participant in the business of professional engineering societies, and is the holder of many awards for technical papers, e.g., the Lowe Gray Award of the Institution of Mechanical Engineers for a theoretical paper on heat engines, and the Water Arbitration Prize for his recent paper dealing with the testing of power station plant. Mr. Horsman is taking up work as a consultant in association with Messrs. Kennedy and Donkin.

* * *

A new electronic potentiometer is described in a publication (No. 197) now available from **Electroflo Meters Co. Ltd.,** Abbey Road, Park Royal, London, N.W.10. The new equipment is a high-speed, continuous balance null-type instrument designed to register low potential electrical values from signal sources such as thermocouples, resistance thermometers, flow meters, strain gauges, shaft-position indicators, etc.

* * *

It is announced by **Birlec Limited** that in view of their expanding business in adsorption plant and gas generators, the division handling these projects, formerly known as the Dryer Division, has been renamed Dryer and Gas Plant Division. The new division will continue to be administered by **T. C. Sanders** (manager), **H. J. Podmore** (sales manager) and **S. A. Gregory** (technical manager).

Nu-way Heating Plants Ltd. announces that, following a complete re-organisation of its training facilities, **Mr. H. W. Burberry,** formerly the company's installation and service manager, has been appointed principal of the Nu-way School of Oil Firing. The Nu-way School of Oil Firing was founded in 1952 to provide elementary instruction on the installation and servicing of oil burners for fitters employed by accredited Nu-way dealers, and in the past six years more than 800 engineers have taken this one week course. During the same period the school has been greatly expanded, so that the courses of varying duration are now run, not only for engineers from all sections of the heating trade, but also for oil company representatives, boilerhouse superintendents, industrial furnace builders, and technical staff from manufacturers of oil-fired heating equipment. In addition, specialised courses are run to meet the particular needs of certain large organisations. Details of the regular courses, which are free, may be obtained from the Bursar, Nu-way School of Oil Firing, Vines Lane, Droitwich.

* * *

Aberdare Cables Ltd., and South Wales Switchgear Ltd., have established new offices at Wilmslow to deal with their many activities in the north of England. Both Aberdare Cables and South Wales Switchgear have for many years had offices in Deansgate, Manchester, but in view of the heavy congestion and difficulty to find sufficiently extensive premises in Manchester, it was thought desirable, since the office did not only deal with Manchester business, but the whole of the north of England, to establish new offices at Wilmslow, away from the heavily congested centre. The manager of the new office is **Mr. W. Harris.**

* * *

It is with regret that we record the recent death of **Mr. W. J. Ling,** of the Bristol office of Ruston & Hornsby Ltd., Lincoln. For the past ten years Mr. Ling was the representative of the company's boiler division in south-western areas of the country.

The 10th annual dinner of the **Foxboro-Yoxall Ltd.** 10-year Service Club was recently held at Wimbledon. Just over a hundred members of the staff were present for the reception and dinner. Afterwards, some twenty new members were presented with their club emblems by Mr. Corodon S. Fuller, vice-president of the Foxboro Company, who had flown over from America for the occasion. In his welcome to the new members, Mr. Fuller emphasised the international character of the Foxboro organisation, and delivered a message of greeting from the secretary of the Foxco 10-year Club in the U.S.A. Mr. L. S. Yoxall, managing director of Foxboro-Yoxall Ltd., spoke of the successful inaugaration, in May, 1958, of the company's new factory at Redhill and outlined the plans for future developments to be completed.

* * *

Mr. J. A. Gay, who was formerly in the commercial department of the authority's industrial group, has been appointed patents exploitation officer to the United Kingdom Atomic Energy Authority in succession to **Mr. T. Benson Gyles.** Inventions developed in the course of atomic energy work and which are available for commercial exploitation continue to be filed at the rate of about eight per month. Many of them may be applied in a wide variety of industries, both inside and outside atomic energy, and the total number of inventions available for use by firms is now well over 400. Application for details of such inventions should be made to Mr. Gay at the United Kingdom Atomic Energy Authority, 11, Charles II Street, London, S.W.1.

* * *

Alfred Herbert Ltd. announces that **Mr. D. M. Gimson,** who was appointed chairman on the death of Sir Alfred Herbert in May, 1957, has now resigned from that position but will continue as a director. **Colonel C. W. Clark** has been appointed chairman in succession to Mr. Gimson. **Mr. J. C. Blair** has been appointed deputy chairman. Both Colonel Clark and Mr. Blair will continue as joint managing directors.

NOTES *Personal* AND *Industrial*

Nuclear Chemical Plant Limited, 22, Carlisle Place, London, S.W.1, the company formed jointly by The Power-Gas Corporation Ltd., Humphreys and Glasgow Ltd., and John Thompson Ltd., for the design and engineering of process and treatment plant for nuclear industry, announce the appointment of **Mr. R. W. Rutherford** (joint deputy managing director of The Power-Gas Corporation Ltd.), as chairman, and **Mr. C. Gresle Farthing** (deputy chairman and joint managing director of Humphreys and Glasgow Ltd.), and **Mr. J. H. N. Thompson,** (deputy chairman and joint managing director of John Thompson Ltd.), as directors. **Mr. C. J. Carter,** a director of John Thompson-Kennicott Ltd., **Mr. C. Robson,** a director of The Power-Gas Corporation Ltd., and **Mr. N. H. Williams,** a director of Humphreys and Glasgow Ltd., are appointed alternate directors. **Mr. R. Jowitt** (Humphreys and Glasgow Ltd.) is appointed general manager and **Mr. E. J. G. Good** (The Power-Gas Corporation Ltd.), secretary.

* * *

Recent appointments made by Metropolitan-Vickers Electrical Co. Ltd. include those of **Mr. R. Crummack,** B.Eng.(Elec.), as assistant superintendent, process and rate department; **Mr. R. G. Nicholas,** Grad.I.Mech.E., as assistant superintendent, process and rate department (method study); **Mr. J. P. Stockbridge,** as assistant superintendent, motor department; and **Mr. W. A. Ciclitira,** B.Eng., A.M.I.E.E., as assistant sales manager, motor department.

* * *

The Crown Agents for Overseas Governments and Administrations, announces that a separate electrical engineering department was established on November 1st, under the direction of **Mr. R. Hugh Jones,** M.Sc., M.I.E.E., M.I.Mech.E., as chief electrical engineer. Mr. Jones, who has been with the Crown Agents since 1949, has previously served in Malaya and also in Ghana where he was chief mechanical and electrical engineer of the Public Works Department.

* * *

Mr. G. O. James, A.M.I.E.E., A.M.B.I.M., who for the past four years has been the Electricity Authority's district labour relations officer for London, has been appointed secretary to the Generating Board's side of the National Joint Industrial Council for the electricity supply industry, and a labour relations officer in the industrial relations department of the Electricity Council. At the time of nationalisation of the industry in 1948, Mr. James was appointed by the then British Electricity Authority to be district labour relations officer in the Southern District. He moved to his present position in 1954.

Mr. R. J. Thomas and **Comdr. E. G. Sutton,** R.N. (Retd.), have been appointed directors of John Thompson (Wolverhampton) Ltd. Mr. Thomas was group welding engineer from 1946 until 1955, when he was appointed manager of John Thompson Conveyor Co. A year later he joined the boards of John Thompson Industrial Constructions Ltd., and the Owl Engineering Co. Cmdr. Sutton joined the Ordnance Division of John Thompson Conveyor Co. as manager in 1955. In 1957 when this division became John Thompson Ordnance Co., he was directly concerned in the manufacturing of equipment associated with a variety of weapons, and in designing and manufacturing the charge fuel-feed machines for Berkeley nuclear power station.

* * *

Mr. K. S. Phillips, B.Sc.(Eng.), A.C.G.I., A.M.I.E.E., has been appointed sales controller of Research and Control Instruments Ltd. Mr. Phillips was with Siemens Edison Swan Ltd. for the past twenty years, his latest appointment with that company being sales manager of the Industrial Valve Division.

* * *

Mr. H. N. Wigan, M.C., M.Inst.Pet., who recently resigned from the board of The Amber Chemical Co. Ltd., has joined the board of Combustion Chemicals Ltd., who now hold the licence for the manufacture and sale throughout the U.K. and Commonwealth of the well-known French fuel additives and sulphur inhibitors, Desulfurol, Dieselfur and allied products.

* * *

The death occurred on October 29th of **Mr. T. Golding,** O.B.E., A.M.I.E.E., a director of W. H. Allen Sons & Co. Ltd., Bedford. Mr. Golding joined the firm in 1910, as assistant in the electrical department, subsequently becoming electrical designer and, later, manager of the department, which position he held from 1923 to 1956. He was elected to the board in 1955 and, after relinquishing his position of electrical manager, continued in his capacity as a director, acting also as a consultant to the company.

* * *

Sturtevant Engineering Co. Ltd. has created within its central organisation, a cathodic protection department, headed by **Mr. J. H. Morgan,** who has recently joined the company. Cathodic protection is an electrical means of safeguarding ships' hulls, metal piling, buried pipework, etc., against corrosion. All enquiries regarding cathodic protection should be addressed to the company's head office, Southern House, Cannon Street, E.C.4.

* * *

Tangyes Limited, engineers, Smethwick, Birmingham, announce the appointment of **Mr. G. Ronald Green** as general sales manager.

Mr. R. Yeoman, general manager for the Hodgkinson Group of Foundries, has been appointed to the Board of A. B. Scorer Limited, a subsidiary company of James Hodgkinson (Salford) Limited.

* * *

G. A. Harvey & Co. (London) Ltd. announce the following staff appointments. **Mr. K. Tardif,** publicity manager, has now taken over the duties of home sales manager and will continue to operate from the company's head office at Greenwich. **Mr. H. Barker,** formerly deputy sales manager, has been appointed export sales manager and will also operate from Greenwich. **Mr. H. F. Jones** has been appointed London area manager controlling the company's London sales office at 58, Victoria Street, London, S.W.1.

* * *

Mr. W. B. Sallitt, general manager of the Nuclear Division of The Superheater Company Limited, has been appointed a special director of the company.

* * *

Mr. Gerald Nabarro, M.P., is to open the conference on clean air, to be held in conjunction with the Factory Equipment Exhibition, at Earls Court, next April. This was announced after the first meeting of the advisory committee for the conference, held in London recently, under the chairmanship of **Mr. G. N. Critchley,** M.Sc., F.R.I.C., M.I.Chem.E.

* * *

James Gordon & Co. Ltd. have recently added a third building to their premises at Dalston Gardens, Stanmore. This provides accommodation for the enlarged projects department necessitated by the constantly expanding work in hand and the incorporation of the power plant division of Elliott Bros. (London) Ltd. in the Gordon Organisation. The building also includes a new stores for spares and service requirements, and a new canteen for the ever increasing number of employees.

* * *

Evershed & Vignoles Ltd. have opened a district office at 14, Yarm Lane, Stockton-on-Tees (telephone No. Stockton 64288). **Mr. W. H. M. Hoyle** will be in charge of this office. The company's Northern area office at 116, Manningham Lane, Bradford 8 (telephone 28083), will continue to hold an overall responsibility for the Northern Counties. Requests for service may be made to either office.

* * *

The London district office of **The British Thomson-Houston Co. Ltd.,** (manager, Mr. J. L. Dixon) is now located at 33, Grosvenor Place, London, S.W.1, where the **British Thomson-Houston Export Co.** (managing director, Mr. E. V. Small) is also located. The telephone number is Belgravia 7011.

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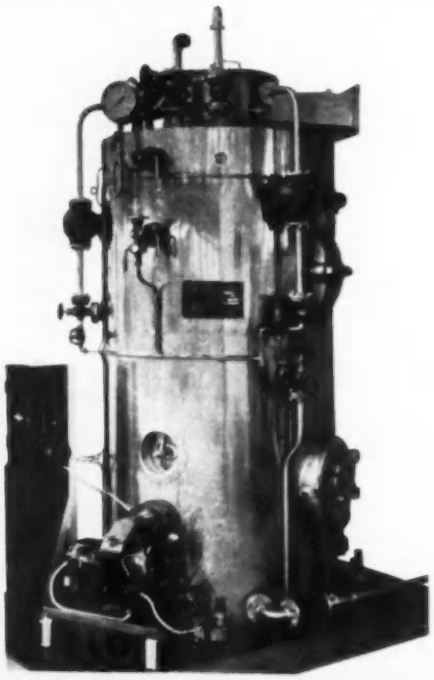

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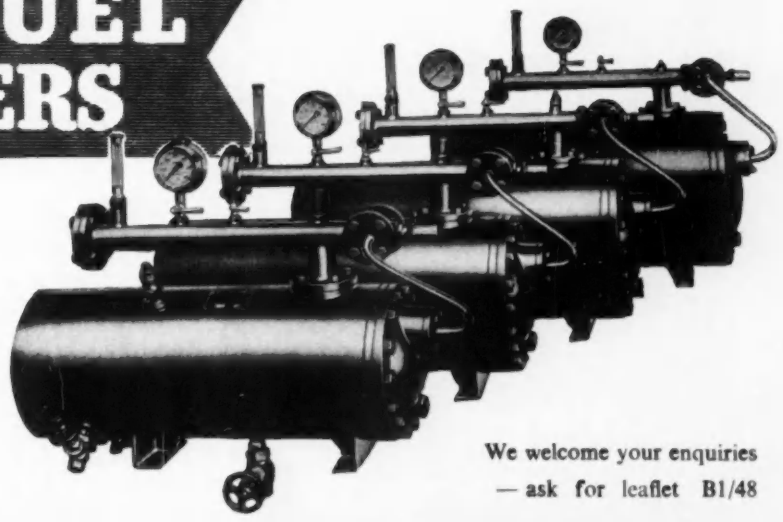

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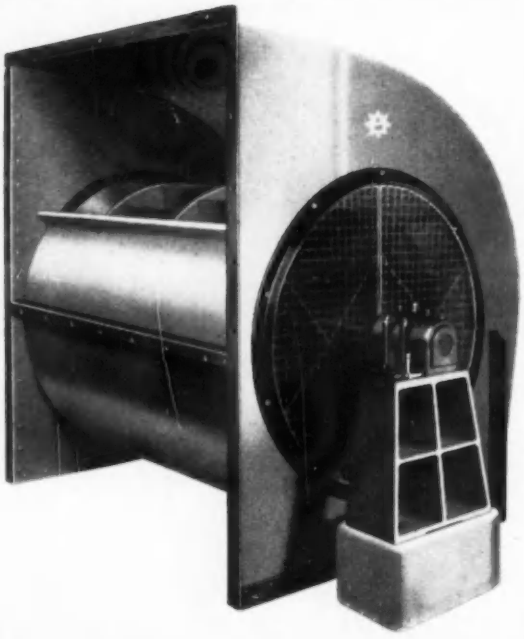

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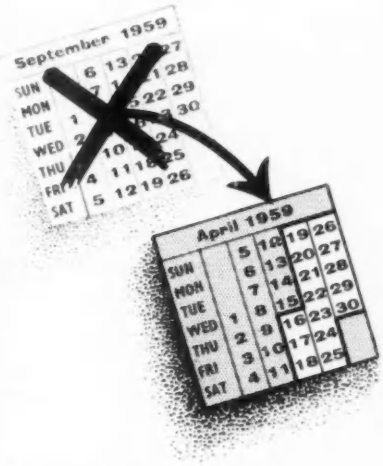

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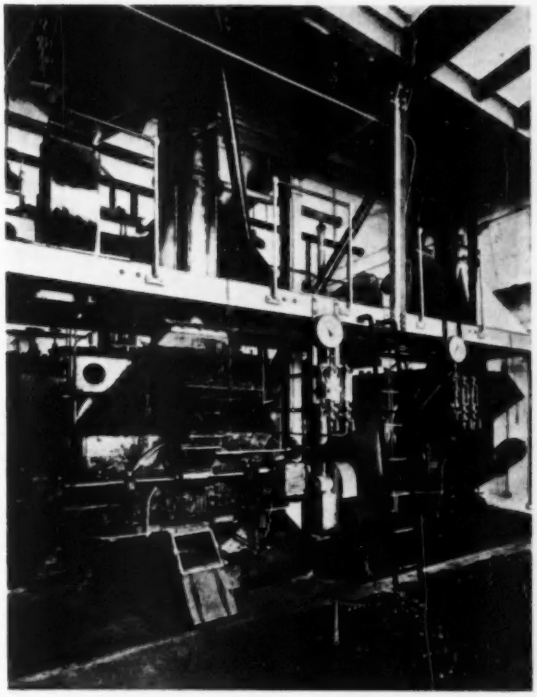

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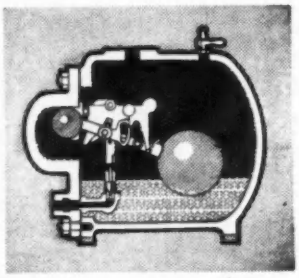

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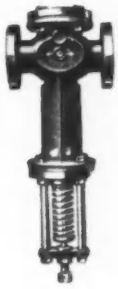

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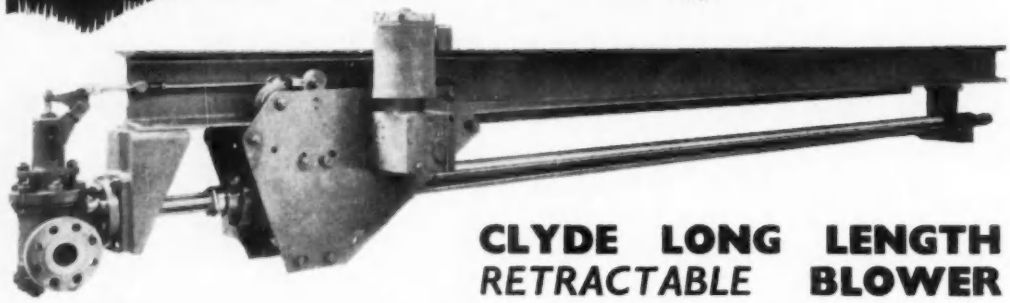

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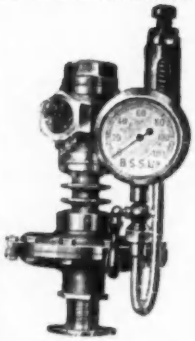

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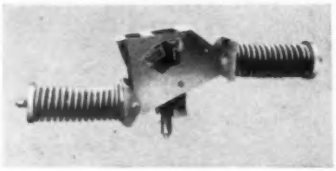

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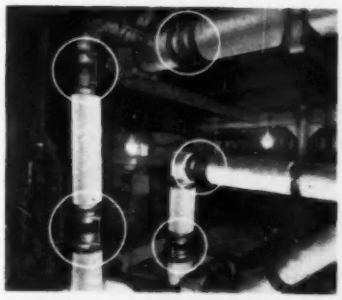

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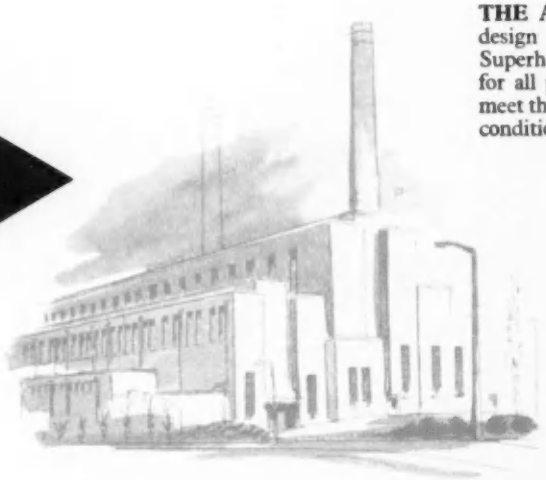

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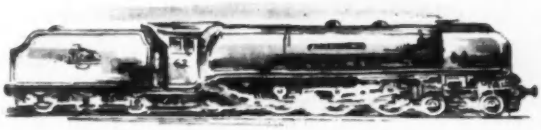

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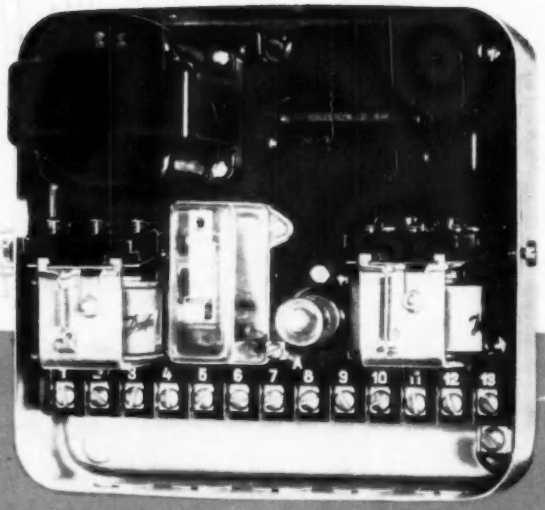

PHOTO RESISTOR FLAME CONTROL ON CONTROL BOX CFS

operating direct on the relay without any amplifier circuit

A semi-conductor photo resistor as flame control is the brand new feature that makes it possible to design the new CFS. The flame control circuit, which converts the impulses from the photo resistor, is made of sturdy reliable components, that

DO NOT "WEAR OUT" OR BREAK DOWN

and replacement of such parts will not normally be required

When the plant is started, the timer of the safety relay is connected. When the flame has been established, ignition and timer are cut out of circuit.
The safety relay will trip if ignition fails, both in case of automatic attempts at restarting the plant and ignition on starting.

A CFS unit means a maximum of security and a minimum of service

Danfoss

AUTOMATIC

CONTROLS AND EQUIPMENT

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